

REPUBLIC of ARMENIA

# THIRD BIENNIAL UPDATE REPORT

UNDER THE UNITED NATIONS  
FRAMEWORK CONVENTION ON CLIMATE CHANGE





**REPUBLIC OF ARMENIA  
MINISTRY OF ENVIRONMENT**

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**UNDER THE UNITED NATIONS  
FRAMEWORK CONVENTION ON CLIMATE CHANGE**

*Armenia's Third Biennial Update Report has been developed by the Ministry of Environment of the Republic of Armenia with the funding of the Global Environmental Facility and support of the United Nations Development Programme in Armenia within the framework of "Armenia's Third Biennial Update Report to the UNFCCC" Project.*



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### **Third Biennial Update Report**

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## **COORDINATION TEAM**

Anna Mazmanyanyan	Project National Director, Deputy Minister of Environment
Dr. Diana Harutyunyan	Project Coordinator
Dr. Marina Sargsyan	Project Task Leader, Editor
Anahit Ispiryan	Project Assistant

Designers: Edvard Martirosyan (internal pages layout)  
Peno Mishoyan (cover page and chapters' opener pages)

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### **Ministry of Environment of the Republic of Armenia**

Address: Government Building #3  
Republic Square, Yerevan 0010, Armenia  
Tel: (37411) 818500, (37410) 583932  
Fax: (37411) 818501, (37410) 583933  
E-mail: [minenv@env.am](mailto:minenv@env.am), [climate@nature.am](mailto:climate@nature.am)  
Website: [www.env.am](http://www.env.am), [www.nature-ic.am](http://www.nature-ic.am)

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## FOREWORD



Within the commitments undertaken by the Republic of Armenia with the United Nations Framework Convention on Climate Change, I am pleased to present Armenia's Third Biennial Update Report, accompanied with the stand-alone 1990-2017 National Inventory Report.

The last two years were severe worldwide due to COVID-19 breakdown followed by the deepest recession of the global economy, and Armenia was no exception. Though facing this severe crisis, climate change remains on the agenda, being a significant challenge to the global community, with intensified consequences on human life and the environment. This is especially true for Armenia, as being a landlocked mountainous country, Armenia is vulnerable to the climate change impacts.

Although Armenia's contribution to anthropogenic greenhouse gas emissions is very small, Armenia is committed to supporting the global call for enhanced climate action.

Thus, The Republic of Armenia ratified the Paris Agreement in 2017, and on April 22, 2021 the Government of Armenia approved Armenia's Nationally Determined Contributions for a ten-year implementation period (2021-2030), setting the new unconditional mitigation target of 40 per cent reduction below 1990 emissions levels, to be achieved in 2030.

As we rebuild from the pandemic, significant further efforts will be needed to promote a "green recovery" and ensuring a low-carbon further development trend. This will require a concerted effort across all sectors of economy and society and primarily in the Energy sector, as a strategic sector for the country to achieve economic growth and national security and the largest emitter of greenhouse gases. It is planned to be done through continuation of legislative and regulatory reforms aimed. The most recently adopted Energy Sector Development Strategic Program aimed at increasing the share of solar energy generation in total to at least 15% by 2030.

I would like to express my appreciation for continued support for climate change mitigation and adaptation measures promotion in Armenia through both bilateral and multilateral international cooperation.

I would also like to use this opportunity to express my gratitude to the Global Environment Facility and the United Nations Development Programme for facilitating the preparation of this report.

Romanos Petrosyan

A handwritten signature in blue ink, appearing to read 'R. Petrosyan', with a stylized flourish at the end.

Acting Minister of Environment  
Republic of Armenia

# LIST OF EXPERTS

## NATIONAL CIRCUMSTANCES

Maria Saponjyan  
Tigran Sekoyan

## GHG INVENTORY

### Energy

Tigran Sekoyan  
Dr. Marina Sargsyan

### IPPU

Vram Tevosyan  
Arshak Astsatryan  
Anzhela Turlikyan  
Torgom Madoyan

### AFOLU

Dr. Anastas Aghazaryan  
Dr. Ashot Hovhannisyan  
Dr. Vahe Matsakyan  
Dr. Susanna Hakobyan

### Waste

Martiros Tsarukyan  
Gohar Harutyunyan

### Uncertainty assessment and Key Category Analysis

Dr. Anna Sikharulidze  
(International expert)

### Inventory data management

Edvard Martirosyan

## CLIMATE CHANGE MITIGATION

Dr. Marina Sargsyan  
Tigran Sekoyan  
Dr. Vahan Sargsyan  
Dr. Anna Sikharulidze  
(International expert)  
Dr. Hrant Gnuni  
Vahan Madoyan  
Vram Tevosyan  
Dr. Ashot Hovhannisyan  
Dr. Anastas Aghazaryan  
Gevorg Zaroyan  
Martiros Tsarukyan

### Gender Aspects

Dr. Astghik Mirzakhanyan

## SUPPORT RECEIVED AND NEEDS

Dr. Levon Barkhudaryan  
Lilit Muradyan

## MEASUREMENT, REPORTING AND VERIFICATION

Dr. Artem Kharazyan  
Apetnak Poghosyan

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## ABBREVIATIONS

ADB	Asian Development Bank
AFOLU	Agriculture, Forestry and Other Land Use
BUR	Biennial Update Report
CBIT	Capacity Building Initiative for Transparency
CDM	Clean Development Mechanism
CEPA	Comprehensive and Enhanced Partnership Agreement
CIF	Climate Investment Funds
CJSC	Closed Joint-Stock Company
CNG	Compressed natural gas
EBRD	European Bank for Reconstruction and Development
E5P	Eastern Europe Energy Efficiency and Environment Partnership
EE	Energy Efficiency
EEU	Eurasian Economic Union
EIB	European Investment Bank
ENA	Electric Networks of Armenia
EU	European Union
FAO	United Nations Food and Agriculture Organization
GAF	German-Armenian Fund
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEFF	Green Economy Financing Facility
GGF	Green for Growth Fund
GHG	Greenhouse gas
GoA	Government of Armenia
GWP	Global Warming Potential
HFHA	Habitat for Humanity Armenia
HPP	Hydropower plant
IFC	International Financial Corporation
IBRD	International Bank for Reconstruction and Development
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
KCA	Key Category Analysis
KfW	Kreditanstalt für Wiederaufbau
LED	Light-emitting diode
LLC	Limited liability company
MOE	Ministry of Environment
MRV	Measurement, Reporting and Verification
NA	Not applicable
NE	Not estimated
NO	Not occurring
NIF	Neighborhood Investment Facility
NCs	National Communications
NDC	Nationally Determined Contributions
NIR	National Inventory Report
NMC	National Mortgage Company
NMVOC	Non methane volatile organic compounds
OECD	Organization for Economic Co-operation and Development
PPP	Purchasing power parity
PSRC	Public Services Regulatory Commission
PV	Photovoltaics
QA/QC	Quality assurance/ Quality control
R2E2	Renewable Resources and Energy Efficiency Fund

RA	Republic of Armenia
RE	Renewable energy
RF	Russian Federation
RTF	Russian Federation Trust Fund
SAR	IPCC Second Assessment Report
SC	Statistics Committee
SEAP	Sustainable Energy Action Plan
SHPP	Small hydro power plant
SMEs	Small and medium-sized enterprises
SREP	Scaling up Renewable Energy Program
SUDIP	Sustainable Urban Development Investment Program
SWH	Solar water heating
TACCC	Transparency, Accuracy, Consistency, Completeness, Comparability
TPES	Total Primary Energy Supply
TPP	Thermal Power Plant
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USD	United States Dollars
USSR	Union of Soviet Socialist Republics
WB	World Bank
WAM	With additional measures
WM	With measures
WOM	Without measures

### Units of Measurement

<b>mm</b>	millimeter
<b>cm</b>	centimeter
<b>m</b>	meter
<b>km</b>	kilometer
<b>m<sup>3</sup></b>	cubic meter
<b>km<sup>2</sup></b>	square kilometer
<b>ha</b>	hectare
<b>g</b>	gram
<b>Gg</b>	gigagram (10 <sup>9</sup> g, or thousand t)
<b>t</b>	ton
<b>toe</b>	tones oil equivalent
<b>GJ</b>	gigajoule (10 <sup>9</sup> J)
<b>TJ</b>	terajoule (10 <sup>12</sup> J)
<b>kWh</b>	kilowatt hour (10 <sup>3</sup> Wh)
<b>MW</b>	megawatt (10 <sup>6</sup> W)
<b>GWh</b>	gigawatt hour (10 <sup>9</sup> Wh)
<b>m/sec</b>	meters per second
<b>°C</b>	degree Celsius

### Chemical Combinations

<b>CO<sub>2</sub></b>	Carbon dioxide
<b>CH<sub>4</sub></b>	Methane
<b>N<sub>2</sub>O</b>	Nitrous oxide
<b>HFCs</b>	Hydrofluorocarbons
<b>PFCs</b>	Perfluorocarbons
<b>SF<sub>6</sub></b>	Sulfur hexafluoride
<b>CO</b>	Carbon monoxide
<b>NO<sub>x</sub></b>	Nitrogen oxides
<b>SO<sub>2</sub></b>	Sulfur dioxide
<b>CFCs</b>	Chlorofluorocarbons
<b>HCFCs</b>	Hydrochlorofluorocarbons

### Energy Units Conversion

1 toe = 41.868 GJ= 11.63 MWh  
1 GWh = 3.6 TJ = 86 toe

# EXECUTIVE SUMMARY



*The Third Biennial Update Report of the Republic of Armenia is developed according to the United Nations Framework on Climate Change (UNFCCC) Decisions 1/CP.16 and 2/CP.17 and provides the updated information reported in the Second Biennial Update Report on national circumstances, greenhouse gas inventory, progress in mitigation policies and actions, Measurement, reporting and verification system as well as on support received and needs.*

*In addition, considering that Energy sector by far is the largest producer of greenhouse gas emissions in the country and has the highest mitigation potential, the Report also provides projections of greenhouse gas emissions in Energy sector up to 2030 based on the main provisions of the latest strategy papers on the Energy sector development adopted in 2021.*

*Armenia's Third Biennial Update Report was developed considering the recommendations provided during International Consultation and Analysis (ICA) process of the Armenia's Second Biennial Update Report, as well as the recommendations of the workshop on Quality Assurance of the National Greenhouse Gas Inventory Management System and National Greenhouse Gas Inventories of Armenia organized by the UNFCCC Secretariat with the collaboration of the FAO.*

*Armenia appreciates the support provided as these processes have greatly contributed to improving the quality of this report by providing more accurate and complete information and eliminating gaps to the extent possible.*

## S-1. National Circumstances

The Republic of Armenia (Armenia) is a landlocked mountainous country vulnerable to the climate change impacts. Its climate ranges from dry subtropical to cold alpine with four seasons. Armenia is an Upper Middle-income Country<sup>1</sup> with USD 13 654 per capita GDP purchasing power parity (PPP) (constant 2017 international \$)<sup>2</sup> and a population of 3.0 million in 2019.

The trade and services sector plays a key role in the national economy, accounting for 52.4% of the GDP in 2019. Given the geographic location of the country and the lack of indigenous industrial-scale fossil fuel resources, development and expansion of economically viable and technically available renewable energy sources, further development of nuclear energy and promotion of energy efficiency are key priorities for Armenia to ensure energy independence and security of the country.

Although as a country Armenia is making very little contribution to anthropogenic greenhouse gas emissions, the country is taking active measures, such as the ratification of the Paris Agreement in September 2015, to continue its low-

carbon trend, thereby contributing to the international community's efforts to respond to climate change.

On 24 November 2017, the Comprehensive and Enhanced Partnership Agreement (CEPA) between the European Union and Armenia was signed (entered into force on 1 March 2021). The Agreement emphasizes the importance of strengthening the multilateral cooperation on the further development and implementation of the international climate-change framework under the UNFCCC and agreements and decisions related thereto, including the Paris Agreement. To address this obligation, the CEPA Implementation Roadmap has been approved by Decision 666-L of the Prime Minister and endorsed at the second meeting of the Armenia-EU Partnership Council on 13 June 2019.

On January 2, 2015, the Treaty on Armenia's accession to the Eurasian Economic Union (EAEU) came into force. The EAEU aimed at the implementation of coordinated policy in various branches of economy within the Union and creation of conditions for sustainable development.

<sup>1</sup> <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519>

<sup>2</sup> <https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.KD>

## S-2. National Greenhouse Gas Inventory

The Republic of Armenia prepared the national greenhouse gas (GHG) inventory from 1990 to 2017 in accordance with the 2006 IPCC (Intergovernmental Panel on Climate Change) Guidelines for national greenhouse gas inventories for: Energy, Industrial Processes and Product Use (IPPU), Agriculture, Forestry and Other Land Use (AFOLU) and Waste Sectors.

The national GHG inventory includes carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrochlorofluorocarbons (HFCs) and sulfur hexafluoride (SF<sub>6</sub>) and they are expressed in units of mass and by carbon dioxide equivalent (CO<sub>2</sub> eq.) using the Global Warming Potentials (GWPs) in the IPCC Second Assessment Report (SAR). The national GHG inventory includes also estimates of carbon monoxide (CO), nitrogen oxides

(NOx), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO<sub>2</sub>).

In 2017, the national GHG emissions were 10,624 Gg CO<sub>2</sub> eq. (excluding *Forestry and Other Land Use*) and net emissions including sinks were 10,153 Gg CO<sub>2</sub> eq. Total emissions in 2017 were 3% higher than those in 2016 mainly because of increased emissions from electricity generation, road transport, residential and cement production sectors. The increased emissions from electricity generation were due to the increased export volumes, in residential sector - due to cold winter, in road transport - due to increased fuel consumption caused by the increase in the number of vehicles and in cement production - due to the increased construction volumes.

## S-3. Mitigation Policies and Actions

On April 22, 2021 the Government of Armenia approved Armenia's Nationally Determined Contributions (NDC) for a ten-year implementation period (2021-2030), setting the new unconditional mitigation target of 40% reduction below 1990 emissions levels, to be achieved in 2030.

In 2018, the Republic of Armenia joined the NDC Partnership to support the implementation of "Nationally Determined Contributions".

The Republic of Armenia is promoting policies to increase the share of renewable energy in the power generation sector, expanding solar generation on demand side, promoting energy savings in all sectors of the economy including expanding the supply of high-efficiency equipment in the industrial and buildings sectors, promoting eco-friendly vehicles

and improving the road infrastructure in the transportation sector.

According to the Republic of Armenia Energy Sector Development Strategic Program (till 2040)", 2021, the RA Government has intended to increase the share of solar energy generation in total to at least 15% or 1.8 billion kWh by 2030. To this end, several legislative and regulatory reforms have been implemented in recent years, aimed at the development and comprehensive upscaling of renewable energy sources, in particular, towards increasing electricity production by solar photovoltaic (solar PVs) power plants to strengthen Armenia's energy security and competitiveness and ensure meeting Armenia's environmental goals and commitments.

## S-4. Support Received and Needs

Armenia continued receiving support for climate change mitigation and adaptation measures. Assistance was provided

through both bilateral and multilateral international cooperation, including the

climate finance, technology transfer, as well as capacity building.

The received international support was aimed at contributing to the country's low-emission development through implementation of sectorial policies and priority programs, as well as the promotion of business solutions which the best serve country's economic and environmental development goals.

Energy sector got the largest amounts of climate-related development finance, as

the key mitigation measures cover primarily the Energy sector, which is the most substantial contributor to national GHG emissions.

Developing and implementing the national Measurement, Reporting and Verification (MRV) system is essential for ensuring national reporting under the Convention and Paris Agreement covering all key reporting areas.

## S-5. Measurement, Reporting and Verification

The basic national MRV system, comprising of horizontal inter-agency coordination and verification mechanism under the overall formal coordination by the Ministry of Environment, has already been established in the country.

However, legal / formal arrangements are still needed to specify obligations of corresponding institutions in terms of climate-related data provision and quality assurance.

Ongoing developments in the country, including legal reforms, recent adoption of the EU-Armenia CEPA Implementation Roadmap, the envisaged reform of the Inter-agency Coordinating Council of Climate Change, etc. will facilitate

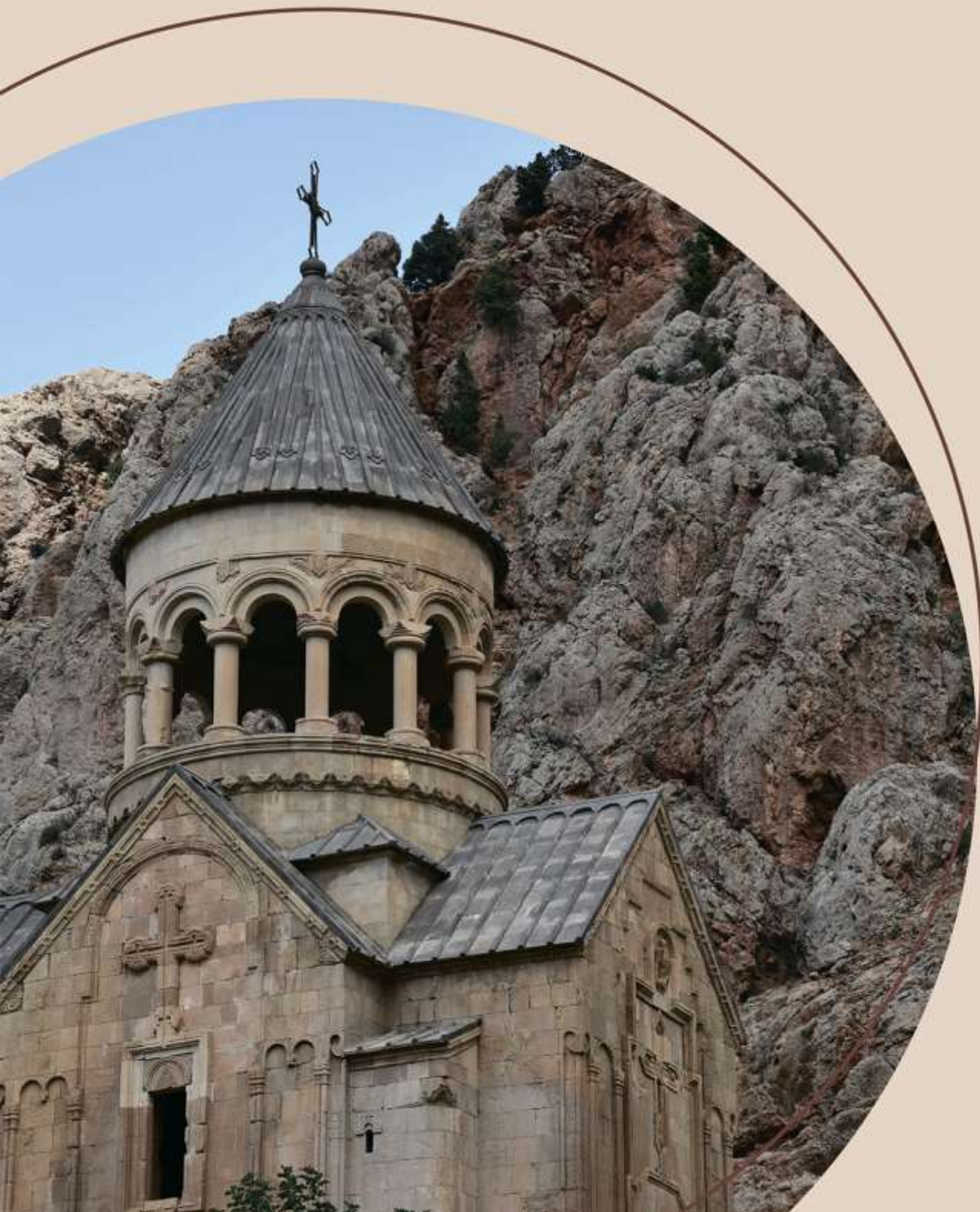
establishment of comprehensive domestic MRV framework.

However, the main support with establishment of an enhanced transparency framework enabling shifting from the current practice of ad hoc reporting to a continuous process of MRV is to be provided through the UNDP-GEF "Building Armenia's national transparency framework under Paris Agreement" project to be implemented under the Capacity Building Initiative for Transparency (CBIT). This will allow the country to track its progress against its commitments under the NDC and ensure national reporting under the Convention and the Paris Agreement.



# CHAPTER 1

## NATIONAL CIRCUMSTANCES AND INSTITUTIONAL ARRANGEMENTS





## 1.1 Location, State Administration, Climate and Natural Resources

### Geographical location

The Republic of Armenia (RA) is a landlocked country in the South Caucasus region. The total area of the country is 29,743 km<sup>2</sup>. Armenia is located in the

western part of Asia, in the north-eastern part of the Armenian Highlands, between the Caucasus and Central Asia. The country borders with Georgia in the north, with Azerbaijan in the east, with Turkey in the west and southwest, and with Iran in the south.

### State administration and administrative-territorial units

In 1991, as a result of the referendum held on September 21, the Republic of Armenia was declared an independent democratic state. In 2018, according to the constitutional amendments adopted in 2015, transition was made to a parliamentary government system.

The country's administrative-territorial division is comprised of 10 marzes (regions) and the capital city of Yerevan. With about 36% of the Republic's population, Yerevan is the main driver of the economy.

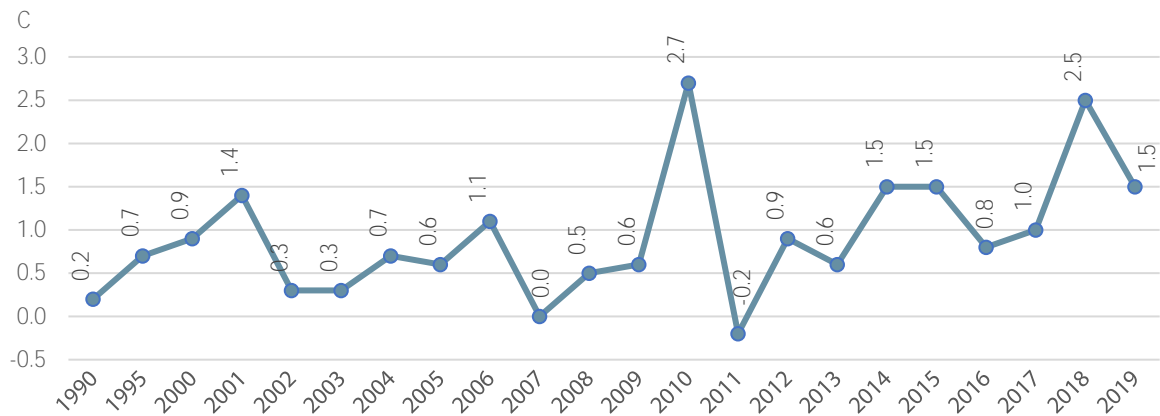
### Relief and climate

Armenia is located in a seismically active zone and due to its highly rugged and complex mountainous terrain, is characterized by a high risk of natural disasters. Mountain ranges occupy about 14 thousand km<sup>2</sup> or 47% of the total area. 90% of the country is located at an altitude higher than 1,000 m above sea level, of which 40% - at higher than 2,000 m. The highest point is 4,090 m - Mount Aragats peak, the lowest point is 375 m - the downstream of the Debed River. The average absolute height is 1,830 m. Intermountain Ararat Valley, the country's most important agricultural region is in the southwest of the country.

Due to its geographical location and complex mountainous terrain, Armenia is distinguished by its climatic diversity. Because of the high-mountainous character, the climate is rather dry continental with hot summers (average temperature +25°C) and cold winters (average temperature -6°C). 6 climatic zones, from dry subtropical to cold alpine, can be distinguished here. Natural climatic conditions in Armenia are enough favorable for solar energy use. Annual average value of sunshine hours is 2500 hours. Average annual flow of solar radiation on horizontal surface is 1720 kWh/m<sup>2</sup>.

In recent decades, a significant increase in temperature has been observed in Armenia. During the period of 1990-2019 deviation of the average annual temperature from the baseline period (1961-1991) was in average 0.9°C. The average annual air temperature in 2019 was 7.0°C. In 2019, a deviation of 1.5°C from annual average temperature for the period of 1961-1990 was recorded. In January 2019, the average temperature was -4.2°C (representing a deviation from the average annual value by 2.6°C), furthermore, in some communities of Shirak region -29°C temperature has been recorded. The average temperature in July was 18.3°C (representing a deviation from the average annual value by 1.2°C), whereas 40°C has been recorded in Yerevan and in some communities of Aragatsotn, Ararat, Armavir and Vayots Dzor marzes.

Along with increasing temperature, an overall tendency for decreased precipitation is observed, with volatilities in the precipitation levels varying by years. The average annual precipitation in 2019 was 448.8 mm, and the deviation from the 1961-1990 average annual precipitation was - 143.2 mm.



**Figure 1.1 Deviation of the average annual air temperature from the baseline period of 1961-1990<sup>1</sup>**

The country is characterized by high frequency and intensity of hydro-meteorological hazardous events, which lead to the damages caused by the events. Heat waves, droughts, landslides, floods, hail and violent storms are among the most

common more extreme weather events.

This hydrometeorological environment has a significant negative impact not only on the population, but also on the most sensitive economic sectors, in particular, agriculture, energy, water resources management.

## Natural Resources

**Land resources.** According to the land balance, 68.7% of the territory of the Republic of Armenia is agricultural lands. More than 50% of them are pastures, about 22% - arable lands.

Lands of specially protected areas account for 11.3%, forests – for 11.2%, land of settlements - 5.1% of lands in total<sup>3</sup>.

**Water resources.** The proper management of water resources plays a key role in the socioeconomic development of Armenia. These water resources are not evenly divided in space and time with significant seasonal and annual variability in river runoff. Thus, the density of the river network in the country varies within a significantly large range - 0-2.5 km/km<sup>2</sup>. Armenia has two major river basins. About 9500 rivers and tributaries flow through the country. The rivers and lakes in Armenia are mainly powered by fresh water. There are about 100 freshwater lakes and ponds in Armenia. Lake Sevan, the largest freshwater body in Armenia, is an important multipurpose water reservoir

for irrigation and hydropower. Its mirror surface in 2019 was 1,279.18 km<sup>2</sup>, with the water level mark at 1,900.57 meters<sup>4</sup>. It is planned to raise the level of Lake Sevan by 6.5 m within a period of 30 years. This will provide additional water reserves, which will serve as a highly important and strategically significant natural resource for energy and other economic sectors<sup>5</sup>.

**Mineral resources.** Armenia lacks industrial-scale fossil fuel resources and rich in mineral resources. Almost all the rocks present in the Earth crust can be found here. Volcanic eruptions have resulted in emergence of significant reserves of natural building materials - tuff, basalt, andesite, perlite and other minerals used in construction. Armenia has significant deposits of copper-molybdenum, polymetallic, building stone, mineral water, precious metals and semi-precious stones. About 900 mineral deposits with approved reserves are accounted for in the State Mineral Resources Balance<sup>6</sup>.

<sup>3</sup> The Government of Armenia Decree N1927-N, 03.12.2020

<sup>4</sup> RA SC, Statistical Yearbook of Armenia

<sup>5</sup> Excerpt N54 from the minutes of the RA Government session dated 28.12.2017, Concept of reforms and development of "Sevan" National Park

<sup>6</sup> <http://www.minenergy.am/page/472>

## 1.2 Socio-demographic outlook

### Population

The permanent population of the Republic of Armenia as of the beginning of 2019 was 2,965.3 thousand. Since 1993 the RA population dynamics was on downward trend due to a decrease of natural growth and emigration rates exceeding natural growth. In 2019, compared to the year

1990, the population of Armenia decreased by 549.6 thousand people or by 15.6%. The natural growth of the population is also on downward trend, which reached 3.4 % in 2019. Life expectancy from birth increased by 8.2% making 76.5 years.

**Table 1.1 Key demographic indicators<sup>7</sup>**

	1990	2000	2010	2015	2016	2017	2018	2019
Population at the beginning of the year, thousand people	3514.9	3226.9	3055.2	3010.6	2998.6	2986.1	2972.7	2965.3
Rate of natural increase (per 1000 population), %	16.3	3.1	5.5	4.6	4.1	3.5	3.6	3.4
Life expectancy from birth, year	70.7	72.9	73.3	75.0	75.0	75.4	75.9	76.5

The population density is 100 people/km<sup>2</sup>. The distribution of the population is highly disproportionate due to the country's mountainous landscape and disproportionate economic development of the regions. The highest population density is observed in the city of Yerevan - 4861 people/km<sup>2</sup> and the lowest - in Vayots Dzor marz - 21 people/km<sup>2</sup>.

As of the beginning of the year 2019, the urban population was 1,894.9 thousand people (63.9%) and the rural population was 1,070.4 thousand people (36.1%). 52.7% of the population are women. Compared to 1990, the share of women increased by 1.2 percentage point.

### Labour market

Labour force participation rate in 2019 was 59.9%, employment rate - 48.9%, the unemployment rate -18.4%.

Women predominate in the structure of labour resources, while men prevail in the number of labour force, employed and unemployed. In 2019, the gender gap in labour force participation rates of female and male was 30.8%, and the gender gap in the average monthly nominal salary - 34.7%<sup>8</sup>, despite the fact that the share of women with higher education in the number of the employed within this group was

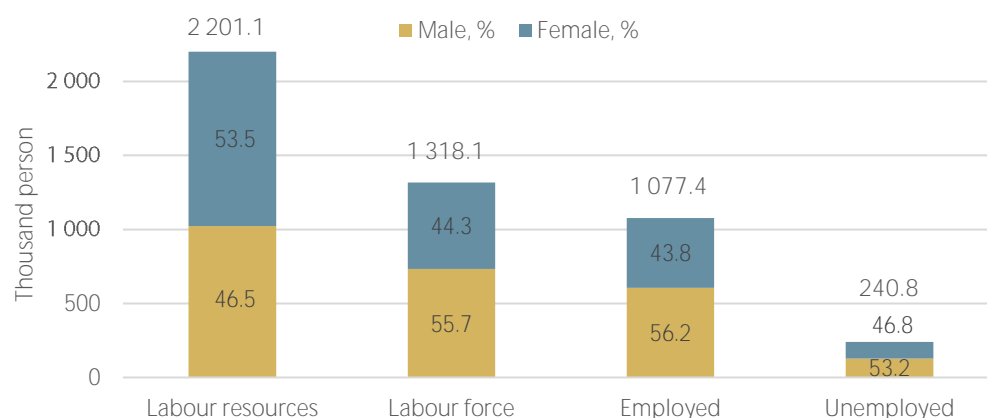
36.0%, compared to men - 29.2%.

One of the key characteristics for the Armenian labour market is labour migration. According to 2019 annual Integrated Living Conditions Survey (ILCS) results, 5.1% of household members were involved in migration flows.

For 69.6% of migrants who left and have not yet returned as of 2019, and for 80.2% of those who returned, the movement is of a cross-border nature

<sup>7</sup> RA SC, Statistical Yearbook of Armenia

<sup>8</sup> RA SC, Women and men in Armenia



**Figure 1.2 Composition of labour resources, 2019<sup>9</sup>**

Since 1990, the sectoral structure of employment has undergone a number of changes, mainly due to changes in the structure of the economy. The most significant changes include the decrease in

the share of employment in industry from 30.4% to 13.8% and the increase in services and trade sector from 40.6% to 55.3%.

## Social snapshot

National poverty ratio in 2019 was 26.4% and the level of extreme poverty was 1.4%. (International Poverty Line, currently set at \$1.90 a day, made up 1.1% in 2019). Despite the substantially decreased poverty level in recent years and the

positive dynamics of the minimum and average wages, the dispersion of income (Gini index) in recent years is on insignificant growth trend, amounting to 0.381<sup>10</sup> in 2019.

## 1.3 Economy

### Dynamics of economic growth

According to the world classification of countries by income groups, Armenia is among the countries with upper middle-income since 2017. In 2019 Armenia's GDP reached 13.7 billion USD, and GDP per capita amounted to 4622.7<sup>11</sup> USD.

Armenia's economy has undergone a profound transformation since independence, making a transition to market-driven economy. The past 29 years have been characterized by two sharp economic downturns followed by a dynamic recovery. Thus, the post-independence recovery started in 1994 and continued until 2008, Armenia has registered strong economic growth with an average annual GDP growth of 8.9%. In 2004 the 1990 GDP level was

exceeded. In the early years the economic growth was mostly due to agriculture, while later economic growth was ensured mainly to the growth of construction and service sectors.

Until the 2008-2009 world financial crisis the economic growth of Armenia was mostly based on non-tradable sectors, as a result of which Armenia's economic recession was one of the deepest in the world: in 2009 the GDP decreased by 14.1%. The recovery began in 2010, mainly through the expansion of the external debt. In 2010-2019 the average GDP growth was 4.5%. In the post-crisis period, the sector of services was the main driver of economic growth.

<sup>9</sup> RA SC, Statistical Yearbook of Armenia

<sup>10</sup> RA SC, Social Snapshot and Poverty in Armenia

<sup>11</sup> WB database. The indicators are presented based on current prices. <https://data.worldbank.org/indicator/NY.GDP.PCAP.CD>

**Table 1.2 Main macroeconomic indicators<sup>12</sup>**

	1990	2000	2010	2015	2016	2017	2018	2019
GDP (current prices), billion AMD	10.1	1,031.3	3,460.2	5,043.6	5,067.3	5,564.5	6,017.0	6,569.0
GDP growth, %	-5.5	5.9	2.2	3.2	0.2	7.5	5.2	7.6
GDP (constant 2010 mln US\$)	6,352.0	4,306.7	9,260.3	11,479.0	11,502.0	12,364.6	13,007.6	13,996.2
GDP, PPP (constant 2017 international mln \$)	18,327.9	12,426.5	26,719.3	33,121.2	33,187.5	35,676.5	37,531.7	40,384.1
GDP per capita, PPP (constant 2017 international \$)	5,180.1	4,048.3	9,286.2	11,321.4	11,303.1	12,115.1	12,715.0	13,653.7
Consumer price index, %	7.8	-0.8	8.2	3.7	-1.4	1.0	2.5	1.4

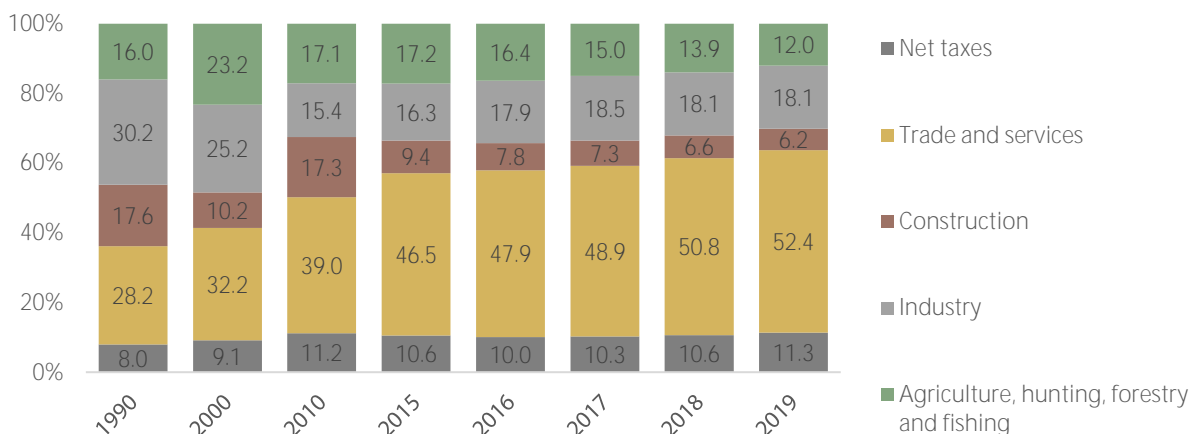
Since transition to market economy Armenia reached quite favourable positions in international rankings thanks to institutional and structural reforms. Thus, Armenia is 47<sup>th</sup> among 190 countries in the “Doing Business” 2020 rating of the World Bank<sup>13</sup>, 34<sup>th</sup> among 180 countries in the 2020 Index of Economic Freedom published by the Heritage Foundation and

is classified in the “mostly free” group<sup>14</sup>, 69<sup>th</sup> among 141 countries in the Global Competitiveness Index 2019 Rankings published by the World Economic Forum<sup>15</sup>, and 81<sup>st</sup> among 189 countries according to the 2019 UN Human Development Index and is classified in the high human development group of countries<sup>16</sup>.

## GDP composition

During 1990-2019, Armenia’s economy has undergone a profound transformation. Thus, in 1990 industrial sector accounted for 29.7% of GDP, in 2000 - 25.2%, while in 2019 this indicator was 18.1%. Similarly, Agriculture, being one of the main sectors of the economy, has been declining since

2000, and reached 12.0% of GDP in 2019. Instead, the share of trade and services continuously expanded from 28.2% in 1990 to 52.4% in 2019 - increased 1.9 times as compared to 1990 and 1.6 times as compared to 2000.

**Figure 1.3 GDP composition, %<sup>17</sup>**

<sup>12</sup> Source: 1,2,6, lines from the RA SC database, 3,4,5 lines from the World Bank database

<sup>13</sup> <https://www.doingbusiness.org/en/reports/global-reports/doing-business-2020>

<sup>14</sup> <https://www.heritage.org/index/>

<sup>15</sup> [http://www3.weforum.org/docs/WEF\\_TheGlobalCompetitivenessReport2019.pdf](http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf)

<sup>16</sup> <http://hdr.undp.org/en/content/2019-human-development-index-ranking>

<sup>17</sup> RA SC database

## Foreign trade

In 2019, exports of goods and services accounted for 41.2% (56.9% - goods, 43.1% - services) and imports accounted for 54.5% (67.1% - goods, 32.9% - services) of GDP. Armenia's current account balance is still negative, at the level of GDP's 7.2%<sup>18</sup>.

The main commodities for exporting goods are mining products (copper, zinc, molybdenum ore, etc.), food products (alcoholic, non-alcoholic beverages, tobacco, etc.), precious and semi-precious

stones, precious metals and items thereof, non-precious metals and items thereof and textile. Most of the exported services - 62.9%, are connected with tourism services.

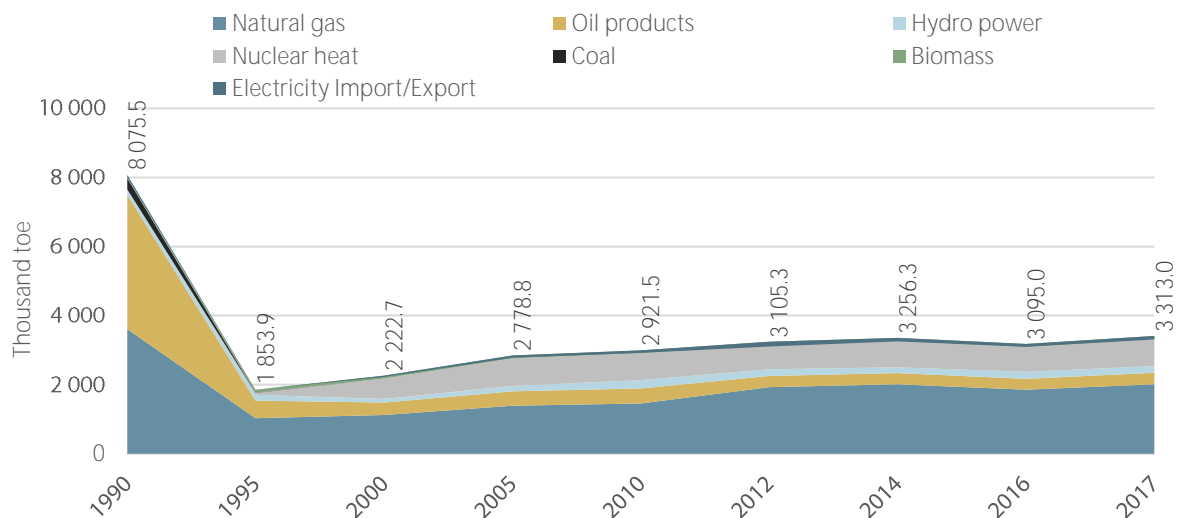
The main commodity groups for importing goods are machineries, equipment and mechanisms, mineral products, mainly fossil fuels - natural gas, oil and oil products, as well as means of transport, etc.

## 1.4 Energy

### Total primary energy supply

Total primary energy supply in 2017 amounted to 3,313 ktoe. Armenia lacks indigenous fossil fuel resources, and the

country's fuel demand is met through imports.



**Figure 1.4 Total primary energy supply, ktoe**

As a result of the economic downturn and subsequent energy crisis during 1991-1993, a sharp decline in primary energy supply was recorded (primary energy supply was reduced 4.3 times in 1995 compared to 1990). Armenia managed to overcome the difficulties of the transition period and to ensure economic growth.

Since 1995, there has been gradual increase in the primary energy supply. As a result, primary energy supply in 2017 made up 41% of the 1990 level, and 49% - per capita. As compared to 2000, primary energy supply in 2017 increased by 49%, and per capita - by 61%.

<sup>18</sup> RA SC Database, RA Balance of Payments



**Table 1.3 Total primary energy supply, 1990-2017, ktoe**

		1990	1995	2000	2005	2010	2012	2014	2016	2017
Natural gas	ktoe	3,608.2	1,029.2	1,122.4	1,394.6	1,459.0	1,924.5	2,008.0	1,851.1	2,013.2
	%	44.7	55.5	50.5	50.2	49.9	62.0	61.7	59.8	60.8
Oil products	ktoe	3,887.6	508.6	357.7	413.4	430.8	326.6	325.4	316.0	328.6
	%	48.1	27.4	16.1	14.9	14.7	10.5	10.0	10.2	9.9
Hydro power	ktoe	160.0	169.5	107.5	152.8	245.9	198.8	171.3	202.4	195.1
	%	2.0	9.1	4.8	5.5	8.4	6.4	5.3	6.5	5.9
Nuclear power	ktoe	0.0	52.5	593.2	802.8	770.9	702.3	753.3	713.8	784.2
	%	0.0	2.8	26.7	28.9	26.4	22.6	23.1	23.1	23.7
Coal	ktoe	320.6	9.5	0.0	0.0	0.7	2.4	0.8	1.2	1.2
	%	4.0	0.5	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Biomass	ktoe	20.1	83.6	81.9	82.2	82.2	87.7	92.7	92.6	87.1
	%	0.2	4.5	3.7	3.0	2.8	2.8	2.8	3.0	2.6
Import/ export of electricity	ktoe	79.0	1.0	-40.0	-67.0	-68.0	-137.0	-95.3	-82.0	-96.3
	%	1.0	0.1	-1.8	-2.4	-2.3	-4.4	-2.9	-2.6	-2.9
<b>Total</b>	<b>ktoe</b>	<b>8,075.5</b>	<b>1,853.9</b>	<b>2,222.7</b>	<b>2,778.8</b>	<b>2,921.5</b>	<b>3,105.3</b>	<b>3,256.3</b>	<b>3,095.0</b>	<b>3,313.0</b>

The overall structure of primary energy supply has also changed. As compared to 1990, in 2017 the share of oil products in the structure of primary energy supply decreased from 48.1% to 9.9% (in absolute terms, by about 91%). The 4% share of coal in 1990 was almost entirely excluded in 2017. The share of natural gas increased from 44.7% to 60.8% (while in absolute value it decreased by about 44%), and the share of nuclear energy was 23.7% against the zero level in 1990. The share of solar and wind power was negligible and therefore not reflected in primary energy supply.

**Electricity generation.** As of the year 2017, electricity generation in Armenia was carried out by the nuclear power plant, large hydro power plants and natural gas fired thermal power plants (including small cogeneration plants), as well as by small renewables (small hydro, wind, solar), with the share of 33.7%, 18.1%, 37.0% and 11.1%, respectively. As of 2017, renewable energy was mainly represented by hydropower plants (small and large).

**Table 1.4 Electricity generation by power plant types, million kWh<sup>19</sup>**

		1990	1995	2000	2005	2010	2012	2014	2016	2017	2018	2019
Thermal power plants	million kWh	8,822.3	3,353.4	2,692.1	1,827.7	1,438.3	3,399.1	3,288.6	2,581.5	2,871.8	3,375.6	3,046.9
	%	85.0	60.1	45.2	28.9	22.2	42.3	42.4	35.3	37.0	43.4	39.9
Hydropower plants	million kWh	1,555.1	1,918.8	1,261.1	1,772.9	2,556.1	2,311	1,992.6	2,351.4	2,269	2,318.2	2,370.9
	%	15.0	34.4	21.2	28.1	39.4	28.8	25.7	32.1	29.2	29.8	31.1
Nuclear power plant	million kWh	-	303.7	2,005.4	2,716.3	2,490	2,322	2,464.8	2,380.5	2,619.6	2,076.1	2,197.8
	%	-	5.4	33.7	43.0	38.4	28.9	31.8	32.5	33.7	26.7	28.8
Wind farms	million kWh	-	-	-	-	7.0	4.1	4.0	1.8	2.1	1.9	3.3
	%	-	-	-	-	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Solar power plants	million kWh	-	-	-	-	-	-	-	-	0.4	5.2	13.4
	%	-	-	-	-	-	-	-	-	0.0	0.1	0.2
<b>Total</b>	<b>million kWh</b>	<b>10,377.4</b>	<b>5,575.9</b>	<b>5,958.6</b>	<b>6,316.9</b>	<b>6,491.4</b>	<b>8,036.2</b>	<b>7,750.0</b>	<b>7,315.2</b>	<b>7,762.9</b>	<b>7,776.9</b>	<b>7,632.3</b>

<sup>19</sup> Public Services Regulatory Commission



Further development and expansion of economically viable and technically available renewable energy sources, development of nuclear energy and promotion of energy efficiency are key priorities for sector development, being critical for Armenia in addressing energy security.

To this end, several legislative and regulatory reforms have been implemented in recent years, aimed at the development and comprehensive upscaling of renewable energy sources, in particular, towards increasing electricity production by solar photovoltaic (solar PVs) power plants.

As a result, as of October 1, 2020, the total installed capacity of the grid connected solar PVs was 80.7 MW, and the total installed capacity of the solar PVs which

were licensed for power generation was 206.8 MW.

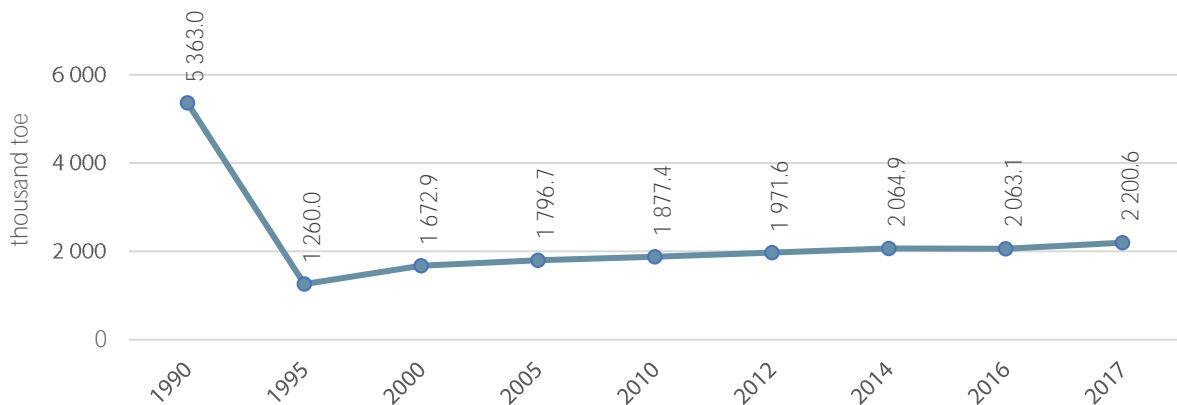
It is planned by 2022 to commission Masrik-1 utility scale solar PV with a peak capacity of 55 MW. Further, new tenders will be held for the construction of another 7 solar PVs with a total installed capacity of about 520 MW, whereby the capacity of two of these plants will be 200 MW each<sup>20</sup>.

According to "The Republic of Armenia Energy Sector Development Strategic Program (till 2040)", 2021, it is planned to increase the share of solar energy generation in total to at least 15% or 1.8 billion kWh by 2030. To this end, solar power plants with the capacity of about 1000 MW, including autonomous ones, are planned to be constructed.

### Final energy consumption

As a result of the energy crisis of the early 1990s, final energy consumption also declined sharply. In 1995 as compared to the year 1990 final energy consumption decreased by 4.3 times or by 76.5%. Steady growth in final consumption has been recorded since 1995 (except in 2016).

As a result, in 2017 final energy consumption increased by about 75% compared to 1995 level, amounting to 2,200.6 ktoe. Whereas compared to the 1990, the final energy consumption in 2017 decreased by 59% and per capita - by 51.2%.



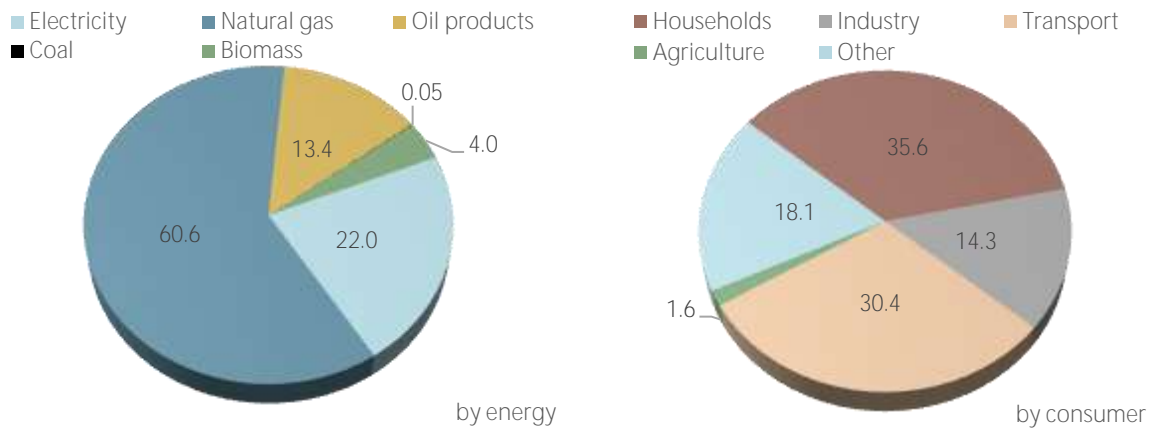
**Figure 1.5 Final energy consumption, ktoe**

Natural gas predominates in final energy consumption with the share of about 60%. This is explained by the high deliverability level in the country - 96% as well as considering that 1 kWh of thermal energy produced by natural gas is about twice cheaper than 1 kWh of electricity. Natural

gas is also commonly used in road transport.

Households are the largest consumers of energy, with consumption in 2017 reaching 35.6%, followed by transport - 30.4%.

<sup>20</sup> RA Energy Sector Development Strategic Program (until 2040)



**Figure 1.6 Final energy consumption structure in 2017, %**

## Sector Regulation

The Ministry of Territorial Administration and Infrastructure is responsible for Armenia's Energy sector policy, while the sector is regulated by the independent body - the Public Services Regulatory Commission (PSRC). Armenia is among the countries where fuel prices are taxed and not subsidized.

Gazprom Armenia CJSC owned by Russia's Gazprom imports natural gas from Russia and Iran as well as owns and operates the gas transmission and distribution networks in Armenia.

The Armenian electricity market has stepped into a phase of liberalization, which means that the market will move from a "one buyer" model to a free electricity purchase and sale mechanism. In the coming years it will move to a new liberalized market model, which will still be for limited competition, but will have a clear path to full liberalization, considering the EEU common energy market development process as well as the Armenia-EU Comprehensive and Enhanced Partnership Agreement<sup>21</sup>.

## 1.5 Industry

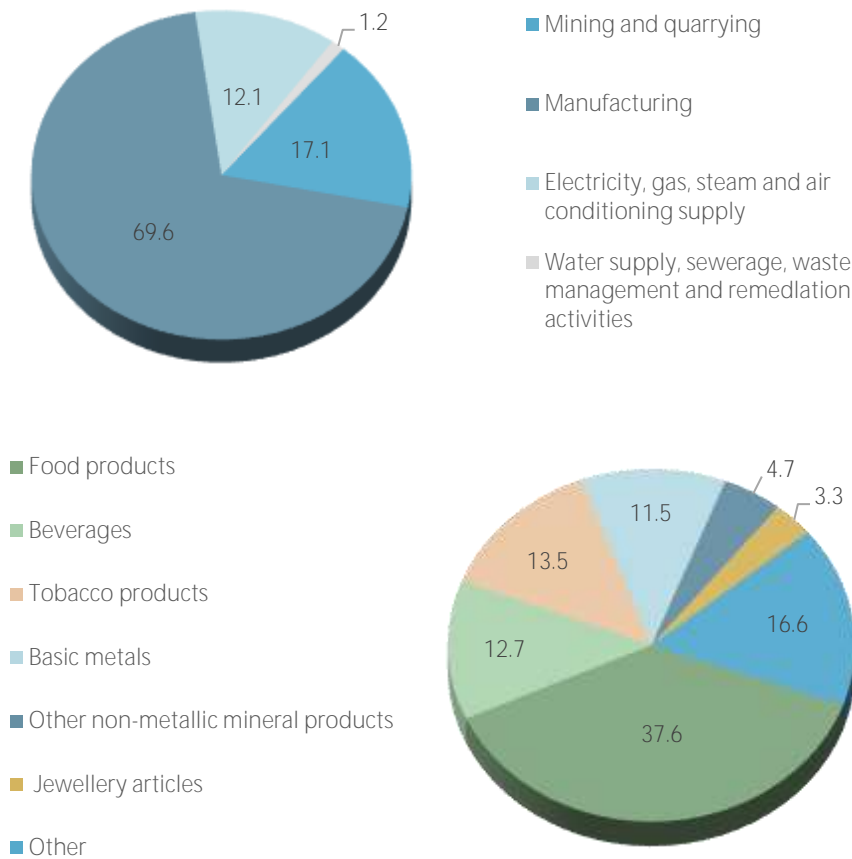
The breakdown of the former USSR and the common economic area coupled with the challenges of transition to a market-driven economy resulted in significant downturn in the industrial sector in 1991-1993: the volume of industrial production in 1993 accounted for 43% of the 1990 level. The country managed to overcome the challenges and during the period from 1995 to 2019 the average growth of industrial production volume was 5.4%. As a result, in 2019 the level of industrial production exceeded the 1990 level 1.6 times making 18.1% of GDP, the index of physical volume of industrial output compared to the

previous year was 108.8%.

The structure of the industry also underwent significant changes. In 2019, the manufacturing sector made up 69.6% of the total industry, with the following key branches; food production (37.6%), tobacco production (13.5%), production of beverages (12.7%), production of basic metals (11.5%).

Mining and quarrying sector accounted for 17.1% of the industry, prevailing segment of which - 96.1% is formed by non-ferrous metal ore mining.

<sup>21</sup> RA Energy Sector Development Strategic Program (until 2040)



**Figure 1.7 Industry structure by sections (left) and manufacturing sector structure (right), 2019, %<sup>22</sup>**

66.6% of those employed in industry are men and 33.4% are women. This imbalance is mainly because about 90% of those employed in the mining industry, and about 88% in the field of electricity, gas, steam and conditioned air supply, are men.

The industrial development vision is essentially based on the further

enhancement and diversification of the manufacturing industry, development of new scientific branches, increase of labour productivity, energy saving. The government targets to achieve the longest possible production chain of raw material processing, strictly adhering to high environmental standards<sup>23</sup>.

## 1.6 Transport

Armenia is a landlocked country, with geopolitical relationships that limit cross-border transport. For economic development purposes, Armenia has serious transport constraints that affect economic competitiveness due to - high transport costs, particularly for traded goods, and expensive infrastructure development and maintenance.

In these conditions, the further development of road transport, the expansion of the

transport network and routes becomes especially important. That is why in recent years, priority has been given to rehabilitation and reconstruction of infrastructure.

The minimum volume of freight transportation was registered in 2000, which was approximately 25 times lower than the 1990 level. In 2019 the volume of freight transportation exceeded the 2000 volumes 3.3 times. Similar tendencies have been registered in the area of passenger

<sup>22</sup> RA NSS, RA statistical yearbook

<sup>23</sup> RA Government Decree N65-A dated 8.02.2019, RA Government program

transportation. In 2000, compared to 1990, it has decreased 3.95 times, and in 2019, compared to 2000 it has increased 1.5 times.

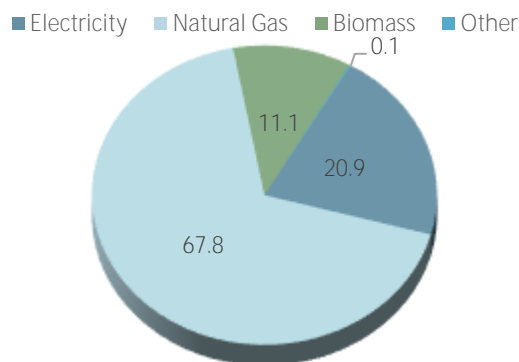
In the structure of freight transportation and passenger transportation, road transport predominates with the share of 65.6% and 84.7% in 2019, respectively. It is noteworthy that with the relatively intensive development of road transport, railroad transport, with some variations maintains its market share (21.8% of cargo

transportation in 2019). This is especially related to the transportation of mining products - 83.4% of delivered freight in 2019 is comprised of non-ferrous metal ore.

Domestic flows significantly prevail in rail-road and road freight transportation, amounting to 56.9% and 59.6% in 2019, respectively. Only foreign freight transportation is carried out by air transport due to the lack of domestic aviation, and in 2019 the export volume was almost twice as much as the import.

## 1.7 Housing

Households are the largest consumers of energy, accounted for 35.6% of final energy consumption in 2017.



**Figure 1.8 Household energy consumption structure, 2017, %**

The natural gas predominates in the structure of final energy consumption by households with the share of about 68% in 2017, the share of electricity - about 21% and biomass - about 11%.

As of 2019, 56.1% of Armenia's housing stock was in cities and 43.9% in villages. About 70% of the total housing stock is allocated to private houses, and 30% - to apartment buildings<sup>24</sup>.

The exterior wall materials of apartment buildings in their majority - about 70%, are made of stone. The share of prefabricated panel-covered buildings is about 23%.

The age of apartment buildings in the housing stock of Armenia is 35-60 years, and during their construction, in fact, energy saving standards were not under consideration. According to various expert estimates, energy consumption per 1 sq.m. is about 3-5 times higher than in developed countries<sup>25</sup>.

For this reason, back in 2014 the RA Government adopted a Decree "On the application of measures aimed at energy saving and increasing energy efficiency in facilities built at the expense of state funds", later- Amendment to the "RA Energy Saving and Renewable Energy" Law, 2016, providing for mandatory compliance with the EE requirements in newly constructed residential buildings and in facilities under construction (reconstructed, repaired) at the expense of state funds, with the subsequent adoption of technical regulation setting energy requirements for energy saving in the mentioned facilities (2018).

At the same time, internationally funded projects are implemented in the country aimed at increasing the energy efficiency of buildings, including the "De-risking and Scaling-up Investment in Energy Efficient Building Retrofits" project funded by the Green Climate Fund.

<sup>24</sup> RA SC, Housing stock and Public Utility in the Republic of Armenia

<sup>25</sup> <http://www.minenergy.am/page/energyefficiency>

## 1.8 Agriculture and Forestry

### Agriculture

Agriculture is the third largest sector of economy, after services and industry. In 1993, after the land privatization and transition to market economy, the share of agriculture in GDP reached 49%. Afterwards, since agricultural land is very fragmented because of privatization in the 1990s, preventing growth in scale and the increase in farm productivity, the share of the sector in GDP has decreased and after the financial and economic crisis of 2009, in 2010-2019 Agriculture sector accounted for 16.9% of GDP in average. As of 2019, Agriculture accounted for 12% of GDP.

However, the Agricultural sector is important in terms of ensuring food security, processing industry (food, beverages, tobacco products, etc.), expansion of the export portfolio, as well as employment in rural communities. As of the beginning of 2019, 36.1% of the population of Armenia is rural, and the number of farms reached 317 thousand. Agriculture accounts for 21.9% of total employment (51.1% men, 48.5% women), compared to 38.6% in the post-crisis period in 2010. At the same time, the reduction in the number of employees is accompanied by an increase in the production of the sector, which indicates a certain increase in sector's efficiency. The RA government intends to double the level of productivity in the sector<sup>26</sup> considering that with this index Armenia is tenfold behind the developed countries.

Designated use of arable lands is only

55%<sup>27</sup> of the total available arable lands, which is pretty low indicator, given the land scarcity in the country. Moreover, only 26.6% of arable lands are considered as irrigated.

During 2019 only 6.2% of agricultural output was produced by commercial organizations and 93.8% by households. Among the obstacles to increasing land use efficiency is the small scale of agricultural farms. This fact does not contribute to a more comprehensive use of innovative technologies in agriculture, which would result in increased overall productivity and efficiency in the sector.

The last decade demonstrated a clear trend of structural shifts within agriculture: crop cultivation has been gradually losing its dominant role in the structure of the sector. In 1995 the share of crop production was 68.5%, in 2010 - 61.7%, and in 2019 - it reached 48.2%. The RA Government targets to achieve equal distribution in the long run: 49.8% crop production and 50.2% cattle breeding by 2029<sup>28</sup>.

Livestock breeding policy is aimed at boosting the supply of pedigree livestock, which, through crossbreeding will improve indicators of local species, including an increase in milk and meat production, and enhancing their competitiveness in relation to similar imported products<sup>29</sup>.

The gross crop yield is mainly obtained from vegetables, potatoes, fruits and berries, grapes, grains and legumes.

### Forestry

The forests account for about 11% of the territory of Armenia and are distributed unevenly. According to the RA land balance approved as of July 1, 2019, the area of forest lands was 334 thousand

hectares, of which about 86% - covered by forests<sup>30</sup>. In terms of their ecological significance, forests in Armenia are classified as protection and special-purpose forests. That's why loggings are

<sup>26</sup> RA Government Decree N1886- L dated 19.12.2019, 2020-2030 strategy outlining key directions ensuring the economic development of the RA agricultural sector

<sup>27</sup> RA land balance as of July 1, 2019

<sup>28</sup> RA Government Decree N 1886-L from 19.12.2019, 2020-2030 Strategy of the main directions of economic development of Armenian agriculture sector

<sup>29</sup> RA Government Decree N327-L of 29.03.2019; RA Livestock breeding development program for the years 2019-2024.

<sup>30</sup> RA SC, Environment and Natural Resources in the Republic of Armenia.



allowed for sanitary purposes only.

On November 30, 2017, the Government of the RA approved the concept of reforms, strategy and action plan for Forest Sector. The reforms aimed at the establishment of a sustainable forest management system to develop and implement state unified policy in the field of preservation, protection, reproduction and use of the forests in Armenia, elimination or mitigation of the negative impact of climate change on the sustainability of forest ecosystems, increase of forest covered areas and improving the species composition,

increasing the effectiveness of the fight against illegal logging. The reforms are based on a change in the management model, according to which the Ministry of Nature Protection (now Ministry of Environment) was acknowledged as the authorized body in the field of forest conservation, protection, reproduction and sustainable use, instead of the previous model of joint management where 75% of the forests were supervised by the Ministry of Agriculture and 25%, which are specially protected areas, were supervised by the Ministry of Nature Protection.

## 1.9 Tourism

Tourism-related services account for 62.9% of Armenia's exports. This testifies to the significant role of the sector in the economy. The RA Government recognizes the sector as one with considerable potential for expansion and promising perspectives. In the last 10 years alone, the number of tourists visiting Armenia has tripled - from 586.8 thousand visitors in 2009 to 1,894.4 thousand visitors in 2019.

This substantial growth in tourism is due to the rich historical and cultural heritage such as historical sites, national cultural monuments and traditions. As the first Christian country in the world, Armenia is rich in ancient monasteries and churches that date back thousands of years.

Another large group of tourist attraction include the nature, natural monuments and areas with unique natural landscapes. Based on the above, dynamic development trends are recorded in tourism sub-sectors such as eco-tourism, gastro-tourism, extreme tourism, ethnic tourism, thus positioning Armenia in the global market as a country offering competitive, diversified tourism products.

To further develop the sector and raise awareness of the country, continuous efforts are needed to develop infrastructure, ensure access to transport routes, achieve affordable prices for air travel services and improve service quality.

## 1.10 GDP energy intensity and greenhouse gas emissions

In 2017 GDP energy intensity index decreased 4.7 times compared to 1990, and almost two-fold as compared to 2000. This is caused by the structural changes in the economy, in particular decreased share of industry and energy-intensive production, growth of the share of services, as well as the introduction of energy-saving technologies.

In 2017 GHG emissions per unit of GDP decreased 4.7 times compared to 1990, and 1.7 times compared to 2000, which in addition to the above-mentioned reasons, is also resulted from the rapid growth of renewable energy (during the period of 1999-2017 installed capacity of small HPPs increased from 31.7 MW to 353.2 MW, i.e., more than 11-fold).

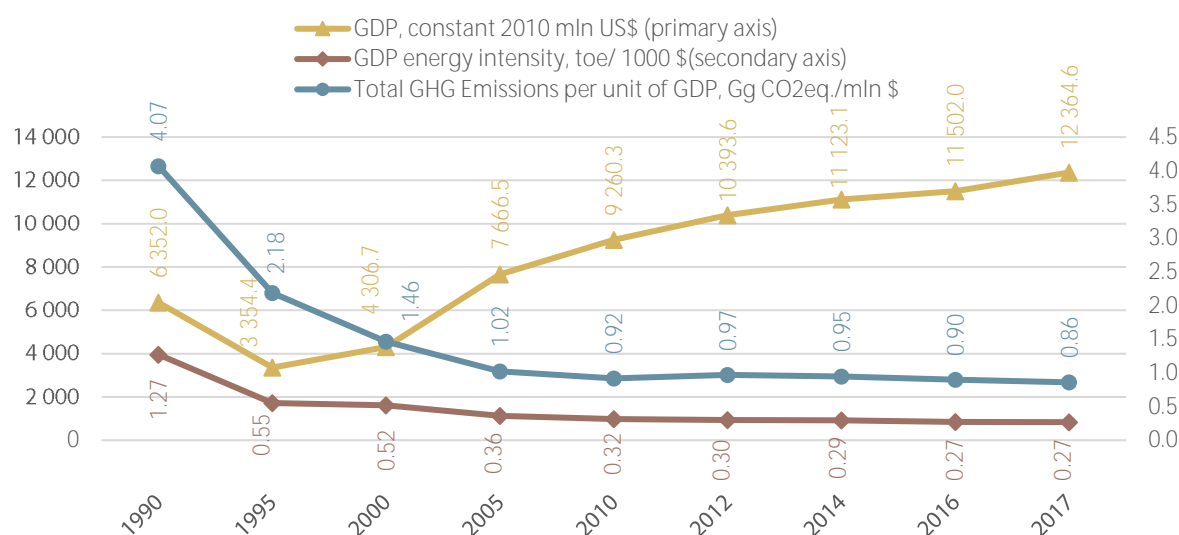


Figure 1.9 GDP, GDP energy intensity and GHG emissions per unit of GDP

Table 1.5 Energy intensity and greenhouse gas emissions<sup>31</sup>

	1990	1995	2000	2005	2010	2012	2014	2016	2017
GDP energy intensity, toe/1000 USD (2010 prices)	1.27	0.55	0.52	0.36	0.32	0.30	0.29	0.27	0.27
Per capita Total Primary Energy Supply, toe/person	2.28	0.57	0.69	0.88	0.96	1.03	1.08	1.03	1.11
GHG emissions per unit of GDP, t CO <sub>2</sub> eq./1000 USD (2010 prices)	4.07	2.18	1.46	1.02	0.92	0.97	0.95	0.90	0.86
CO <sub>2</sub> emissions per unit of GDP, t/1000 USD (2010 prices)	3.39	1.14	0.76	0.55	0.50	0.54	0.51	0.44	0.46

## 1.11 Institutional arrangements for continuous development of national communications and biennial update reports

Republic of Armenia ratified the UN Framework Convention on Climate Change (UNFCCC) in May 1993, the Kyoto Protocol in December 2002, and subsequently the Doha Amendment and Paris Agreement in February 2017.

The obligations of the Republic of Armenia under these international agreements are emanating from its non-Annex I developing country status under the UNFCCC. The country’s position under the Convention and Paris Agreement was formulated in the “Intended Nationally Determined Contributions” (INDC) which was approved by the Government of Armenia on September 10, 2015 by Protocol Decree N 41-5 and submitted to the UNFCCC on September 22, 2015. The updated NDC for the period 2021-2030 approved by the Government of Armenia on April 22, 2021.

Since the ratification of the UNFCCC, the Government of Armenia once every five years approves a list of measures as well as assigns responsible agencies for implementing the country’s commitments under international environmental conventions, including the UNFCCC. The list of measures to be implemented during 2017-2021 to fulfill obligations and provisions arising from the UNFCCC and Paris Agreement was approved by the Government Protocol Decree N 49-8 of December 8, 2016.

The Ministry of Environment (MoE) of the Republic of Armenia is the statutory entity responsible for the development and implementation of state policy addressing climate change issues and is responsible for fulfilling commitments under UNFCCC, including development of national

<sup>31</sup> The calculations are based on 2010 GDP constant prices, and average annual population.



communications, biennial update reports and GHG Inventories. The MoE is designated National Focal Point for the UNFCCC.

In 2015 a Climate Change policy division and from June 2020 - separate department has been established with the main functions of coordinating the UNFCCC implementation including development of national communications and biennial update reports.

National climate change policies and actions are coordinated by the *Inter-agency Coordinating Council for Implementation of Requirements and Provision of the UN Framework Convention on Climate Change*, which was established in 2012 by the Prime Minister’s Decree. The Council has the authority to coordinate reporting on climate change and ensure coherent policies for achievement of Armenia’s commitments under UNFCCC and is the decision-making body that approves the final drafts such as the national GHG inventories, NCs, BURs.

The Council is chaired by the Minister of Environment and is composed of repre-

sentatives of ministries, state agencies, including the Statistics Committee and independent bodies (the Public Services Regulatory Commission and the National Academy of Sciences). Technical cooperation is ensured through *Working Group* under the *Council* that consists of professionals nominated by their respective ministries and agencies.

Given the changes in the Government structure and to improve the process of development of the low carbon and climate-resilient policies and reporting under the Paris Agreement, the Inter-agency Coordinating Council composition is currently being revised.

The United Nations Development Programme (UNDP) through its Climate Change Program supports the Ministry of Environment, as an authorized national entity, in fulfilling the country’s obligations under UNFCCC including the preparation of national communications, biennial update reports and GHG inventories.

The detailed description of the existing institutional arrangements, gaps and needs as well as improvements foreseen are provided in the Chapter 5.

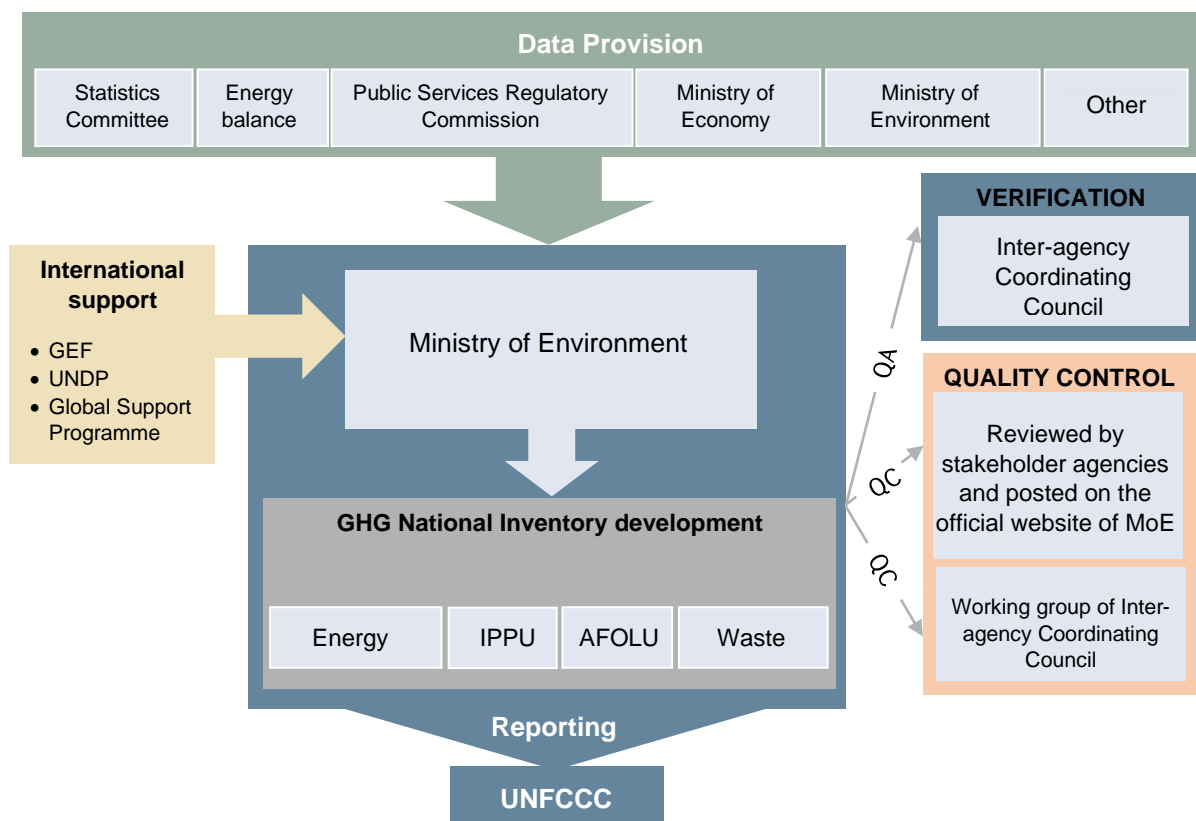


Figure 1.10 Institutional arrangements of GHG Inventory development in Armenia

## CHAPTER 2

# NATIONAL GREENHOUSE GAS INVENTORY



## 2.1 Basic Information on greenhouse gas inventory

Armenia's 1990-2017 National Inventory Report (NIR) has been prepared in accordance with the 2006 IPCC (*Intergovernmental Panel on Climate Change*) *Guidelines for national greenhouse gas inventories*.

Full details of the results, the methodologies, and the steps followed are provided in the Armenia's 1990-2017 National Inventory Report as a stand-alone report. The updates in the national GHG inventory are due to recalculations and the inclusion of new estimates in recent years. Recalculations have been conducted on GHG emission estimates for 1990 - 2017 for all sectors due to the discovery of new datasets and addition of new emission sources.

The national GHG inventory includes carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrochlorofluorocarbons (HFC<sub>s</sub>) and sulfur hexafluoride (SF<sub>6</sub>) and they are expressed in units of mass and in carbon dioxide equivalent (CO<sub>2</sub> eq.) using the Global Warming Potentials (GWP<sub>s</sub>) in the IPCC Second Assessment Report (SAR).

The national GHG inventory includes also estimates of carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>), non-methane volatile organic compounds (NMVOCs) and sulphur dioxide (SO<sub>2</sub>).

According to 2006 IPCC Guidelines, GHG NIR includes the following sectors:

- Energy
- Industrial Processes and Product Use (IPPU)
- Agriculture, Forestry and Other Land Use (AFOLU)
- Waste

Given the key provisions in the Decision 1/CP.16 and following the guidelines in

Annex III of Decision 2/CP.17 on reporting information on national GHG inventories in the BUR for non-Annex I countries, the Armenia's GHG NIR includes:

- Summary report of national GHG inventory
- Inventory sectorial tables according to the 2006 IPCC Guidelines
- Key category analysis (KCA)
- Uncertainty analysis
- Consistent time series for years 1990-2017
- Summary information table of inventories for previous submission years from 1990 to 2017.

Within the frames of the 1990-2017 NIR certain improvements were made to the GHG inventory to align it more with TACCC principles (Transparency, Accuracy, Consistency, Completeness, and Comparability), in particular:

- Emissions of the sulfur hexafluoride (SF<sub>6</sub>) have been estimated for the first time
- GHG emissions of 6 new sub-categories were included
- Higher Tier for 5 sub-categories was introduced
- Key category analysis was done both by Level and Trend assessment
- Uncertainties have been assessed for all sub-categories of emissions and removals
- Emissions estimate for the entire time series were recalculated

Improvements to the GHG inventory are presented in detail in Armenia's 1990-2017 National Inventory Report.

## 2.2 Overview of used methodology

### Guidelines

GHG inventory was prepared according to the 2006 IPCC *Guidelines for National Greenhouse Gas Inventories*. The IPCC *Inventory Software version 2.69.7235* was used for data entry, emission calculation, results analysis and conclusions.

*“Good Practice Guidelines and Uncertainty Management in National Greenhouse Gas Inventories”* (IPCC 2000), *“Good Practice Guidelines for Land Use, Land Use Change and Forestry”* (IPCC 2003) and 2013 *Supplement to the 2006 IPCC Guidelines*



for National Greenhouse Gas Inventories: Wetland, as well as if needed “1996 IPCC Revised Guidelines for National Greenhouse Gas Inventories” were also used during the preparation of the National Inventory for default values of certain parameters.

Regarding the emissions of precursor gases, these were estimated mostly using the methodology “Air Pollutant Emission Inventory Guidebook” (EMEP/EEA, 2009, 2016), except for emissions derived from biomass burning (category 3C1; NO<sub>x</sub> and CO) which were estimated using the 2006 IPCC Guidelines and the IPCC Inventory Software.

### Global warming potentials

**Table 2.1 Global warming potential (GWP) values**

GHG	GWP
CO <sub>2</sub>	1
CH <sub>4</sub>	21
N <sub>2</sub> O	310
HFC-32	650
HFC-125	2,800
HFC-134a	1,300
HFC-152a	140
HFC-143a	3,800
HFC-227ea	2,900
SF <sub>6</sub>	23,900

The estimated CH<sub>4</sub>, N<sub>2</sub>O, HFCs and SF<sub>6</sub> emissions were converted to CO<sub>2</sub> equivalent (CO<sub>2</sub> eq.) using Global Warming Potentials (GWPs) values provided by the IPCC in its Second Assessment Report (“1995 IPCC GWP Values”) based on the effects of GHGs over a 100-year time horizon (Table 2.1).

### Methodologies

The GHG inventory was prepared according to the principles described below:

- Clear observation of the logic and structure of 2006 IPCC Guidelines.
- Priority given to the use of national data and indicators.
- Utilization of all possible sources of information.
- Maximum use of the capacities of national information sources.

During the preparation of the GHG inventory the highest priority was given to the estimation of the emissions of CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O from the key categories, as well as for emissions of hydrofluorocarbons (HFCs) compounds and sulfur hexafluoride (SF<sub>6</sub>).

Estimations were also made for CO, NO<sub>x</sub>, NMVOCs and SO<sub>2</sub> emissions.

Emission estimates were based on the sectoral approach applying Tier 1, Tier 2 and Tier 3 methods.

Country-specific approaches were used for key categories wherever possible to produce more accurate emissions estimate than Tier 1 approach.

The Tier 3 method was used for estimating emissions of CO<sub>2</sub> in:

- Energy sector - from electricity generation by natural gas fired TPPs,
- IPPU Sector - from cement production,

Considering that both sub-categories were identified as key and disaggregated data were available.

The Tier 2 method was used for estimating emissions from the following key categories:

In Energy sector:

- Emissions of CO<sub>2</sub> from stationary (with the exception of electricity generation) and mobile combustion of natural gas, as well as for CH<sub>4</sub> emissions estimating from fugitive emissions of natural gas (The Tier 1 method was used for the emission estimates from liquid fuel combustion).

In IPPU sector:

- Emissions of HFCs from refrigeration and air-conditioning were estimated applying the Method 2A (estimation performed at a disaggregated level with country-specific data by sub-application and a default emission factor selected by sub-application from the 2006 IPCC Guidelines) considering that this sub-category was identified as key and data were available in each sublevel.
- Emissions of HFCs from the other applications were estimated by applying Method 1a (estimation performed at an aggregated level, with country-specific data by application and default emission factor by application from the 2006 IPCC Guidelines).

In AFOLU sector:

- Emissions of CH<sub>4</sub> from enteric fermentation and manure management of cattle, buffalo and sheep.
- Net CO<sub>2</sub> removals from Forest Land Remaining Forest Land.

In Waste sector:

- CH<sub>4</sub> emissions from solid waste disposal.

Other emissions were estimated with the Tier 1 method with default estimation parameters from the 2006 IPCC Guidelines and country-specific activity data.

In addition to assessments based on Sectoral Approach the emissions of CO<sub>2</sub> from fuel combustion were also assessed by Reference Approach and the results were compared for checking purposes.

## 2.3 Main outcomes of greenhouse gas inventory

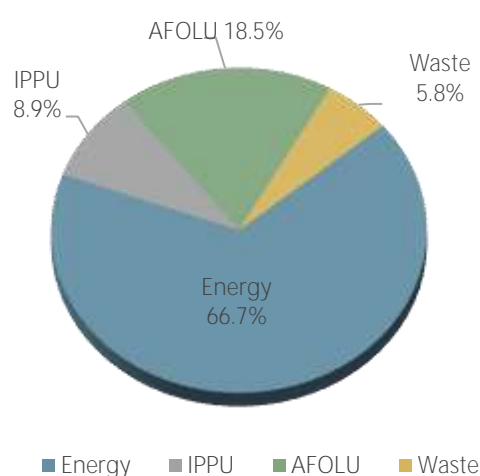
Armenia's greenhouse gas total emissions in 2017 were 10,624 Gg CO<sub>2</sub> eq. (excluding *Forestry and Other Land Use*) - 3% higher than in 2016.

Table 2.2 provides GHG emissions by gases and by sectors for 2017.

**Table 2.2 Greenhouse gas emissions by gases and by sectors for 2017, Gg**

Sector	Net CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	HFCs CO <sub>2</sub> eq.	SF <sub>6</sub> CO <sub>2</sub> eq.	Total CO <sub>2</sub> eq.
Energy	5,361.5	80.6	0.11	NA	NA	7,087.4
Industrial Processes <sup>32</sup>	262.6	NA	NA	NA	NA	262.6
F-gases <sup>33</sup>	NA	NA	NA	685.3	2.6	687.9
AFOLU (without <i>Forestry and Other Land Use</i> ) <sup>34</sup>	2.7	48.2	3.1	NA	NA	1,965.4
Waste	4.3	25.9	0.2	NA	NA	620.7
<b>Total GHG Emissions</b>	<b>5,631.1</b>	<b>154.8</b>	<b>3.4</b>	<b>685.3</b>	<b>2.6</b>	<b>10,624.0</b>
Forestry and Other Land Use	-471.0	NA	0.001	NA	NA	-470.6
<b>Net GHG Emissions</b>	<b>5,160.1</b>	<b>154.8</b>	<b>3.4</b>	<b>685.3</b>	<b>2.6</b>	<b>10,153.5</b>

Shares of GHG emissions by the IPCC sectors are provided in Figure 2.1.



**Figure 2.1 GHG emissions by sectors (without *Forestry and Other Land Use*), 2017, CO<sub>2</sub> eq.**

The Energy sector is by far the largest producer of greenhouse gas emissions. In 2017, the Energy sector accounted for 66.7% of Armenia's total GHG emissions. The Energy sector includes emissions from all use of fuels to generate energy including fuel used in transport and the fugitive emissions related to the transmission, storage and distribution of natural gas.

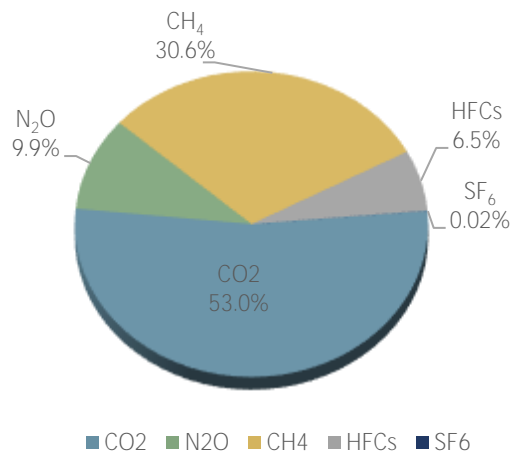
The second largest source of emissions was AFOLU Sector (without *Forestry and Other Land Use*) with a share of 18.5%, followed by IPPU and Waste sectors - 8.9% and 5.8%, respectively.

<sup>32</sup> Excluding F-gases

<sup>33</sup> F gases refer to hydrochlorofluorocarbons (HFCs) and sulfur hexafluoride (SF<sub>6</sub>)

<sup>34</sup> *Forestry and Other Land Use* refers to *Land* category

Figure 2.2 provides greenhouse gas emissions by gases.



**Figure 2.2 Greenhouse gas emissions by gases, 2017**

The Energy sector is mainly responsible for carbon dioxide emissions - it produced over 95% of all carbon dioxide emissions, because of high emissions volume from thermal power plants, road transportation and residential sector.

CO<sub>2</sub> emissions from IPPU sector are significantly less and made about 4.7% of total carbon dioxide emissions, CO<sub>2</sub> emissions from Waste sector are negligible.

Methane emissions accounted for nearly 31% of the total emissions in 2017. Methane emissions are also mostly from the Energy sector (about 52%) due to the fugitive emissions from the natural gas

### Key Category Analysis

Key Category Analysis has been performed for absolute values of emissions and removals (level assessment) based on 2017 inventory, as well as for the trends - based on 2000 and 2017 inventories, as Armenia has undergone significant administrative and economic transition

The most significant greenhouse gas of Armenia's inventory is carbon dioxide (CO<sub>2</sub>), with a share of about 53% of the total emissions in 2017, followed by methane (CH<sub>4</sub>) - about 30.6%. Nitrous oxide (N<sub>2</sub>O) accounted for 9.9% of the total emissions in 2017 and HFCs accounted for roughly 6.5% of all GHG emissions. The share of SF<sub>6</sub> is negligible.

system. The second one with its share of methane emissions is AFOLU sector (without *Forestry and Other Land Use*) - over 31% mainly due to the emissions from enteric fermentation, while the Waste Sector is the third (nearly 17%).

Nitrous oxide emissions made up close to 10% of the total emissions. Most of nitrous oxide emissions (about 90%) are from the Agriculture sector mainly due to the direct and indirect N<sub>2</sub>O emissions from managed soils.

F-gases (HFCs and SF<sub>6</sub>) accounted for roughly 6.5% of total GHG emissions, but their share has been growing continuously.

since 1990. Hence, 2000 has been used as a base year for trend assessment.

Key categories of Armenia's 2017 GHG inventory according to Level assessment are presented in Table 2.3 and according to Trend assessment - in Table 2.4

**Table 2.3 Key categories of Armenia's GHG inventory according to Level (2017) assessment**

A	B	C	D	E	F	G
IPCC Category codes	IPCC Category	Greenhouse gas	2017 Ex,t Gg CO <sub>2</sub> eq.	Ex,t  Gg CO <sub>2</sub> eq.	Lx,t	Cumulative Total of Column F
1.B.2.b	Fugitive emissions from Natural Gas transportation and distribution	CH <sub>4</sub>	1,626.88	1,626.88	14.45%	14.45%
1.A.1	Energy Industries - Gaseous Fuels	CO <sub>2</sub>	1,297.95	1,297.95	11.53%	25.98%
1.A.4.b	Residential- Gaseous Fuels	CO <sub>2</sub>	1,264.95	1,264.95	11.24%	37.22%
1.A.3.b	Road Transportation - Gaseous Fuels	CO <sub>2</sub>	971.86	971.86	8.63%	45.86%
3.A.1.a	Enteric Fermentation - Cattle	CH <sub>4</sub>	849.02	849.02	7.54%	53.40%
1.A.3.b	Road Transportation - Liquid Fuels	CO <sub>2</sub>	721.73	721.73	6.41%	59.81%
3.C.4	Direct N <sub>2</sub> O Emissions from managed soils	N <sub>2</sub> O	671.00	671.00	5.96%	65.77%
2.F.1	Refrigeration and Air Conditioning	HFC <sub>s</sub>	653.92	653.92	5.81%	71.58%
1.A.4.a	Commercial/institutional - Gaseous Fuels	CO <sub>2</sub>	531.42	531.42	4.72%	76.30%
3.B.1.a	Forest land Remaining Forest land	CO <sub>2</sub>	-523.92	523.92	4.65%	80.96%
4.A	Solid Waste Disposal	CH <sub>4</sub>	426.22	426.22	3.79%	84.74%
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO <sub>2</sub>	407.67	407.67	3.62%	88.36%
2.A.1	Cement production	CO <sub>2</sub>	224.55	224.55	1.99%	90.36%
3.C.5	Indirect N <sub>2</sub> O Emissions from managed soils	N <sub>2</sub> O	181.67	181.67	1.61%	91.97%
3.A.1.b-j	Enteric Fermentation - Other	CH <sub>4</sub>	124.48	124.48	1.11%	93.08%
4.D	Wastewater Treatment and Discharge	CH <sub>4</sub>	105.60	105.60	0.94%	94.02%
1.A.4	Other Sectors - Liquid Fuels Agriculture	CO <sub>2</sub>	69.49	69.49	0.62%	94.63%
4.D	Wastewater Treatment and Discharge	N <sub>2</sub> O	68.16	68.16	0.61%	95.24%



**Table 2.4 Key categories of Armenia's GHG inventory according to Trend (2017) assessment**

A	B	C	D	E			F	G	H
IPCC Category code	IPCC Category	Greenhouse gas	2000 Year Estimate Ex0 (Gg CO <sub>2</sub> eq.)	2017 Year Estimate Ext (Gg CO <sub>2</sub> eq.)	2000 Year Estimate (absolute)  Ex0  (Gg CO <sub>2</sub> eq.)	2017 Year Estimate (absolute)  Ext  (Gg CO <sub>2</sub> eq.)	Trend Assessment (T <sub>xt</sub> )	% Contribution to Trend	Cumulative Total of Column G
1.A.1	Energy Industries - Gaseous Fuels	CO <sub>2</sub>	1,696.99	1,297.95	1,696.99	1,297.95	0.245	23.95%	23.95%
1.A.4.b	Residential- Gaseous Fuels	CO <sub>2</sub>	170.43	1,264.95	170.43	1,264.95	0.143	13.98%	37.93%
1.A.3.b	Road Transportation - Gaseous Fuels	CO <sub>2</sub>	55.20	971.86	55.20	971.86	0.129	12.65%	50.57%
2.F.1	Refrigeration and Air Conditioning	HFCs	0.90	653.92	0.90	653.92	0.096	9.42%	59.99%
1.A.4.a	Commercial/institutional - Gaseous Fuels	CO <sub>2</sub>	35.16	531.42	35.16	531.42	0.069	6.79%	66.78%
3.B.1.a	Forest land Remaining Forest land	CO <sub>2</sub>	-470.82	-523.92	470.82	523.92	0.059	5.81%	72.60%
1.A.3.b	Road Transportation - Liquid Fuels	CO <sub>2</sub>	626.80	721.73	626.80	721.73	0.055	5.35%	77.94%
1.B.2.b	Fugitive emissions from Natural Gas transportation and distribution	CH <sub>4</sub>	1,106.49	1,626.88	1,106.49	1,626.88	0.044	4.34%	82.29%
3.A.1.a	Enteric Fermentation - Cattle	CH <sub>4</sub>	634.96	849.02	634.96	849.02	0.038	3.71%	86.00%
4.A	Solid Waste Disposal	CH <sub>4</sub>	359.38	426.22	359.38	426.22	0.030	2.89%	88.89%
1.A.2	Manufacturing Industries and Construction - Gaseous Fuels	CO <sub>2</sub>	345.63	407.67	345.63	407.67	0.029	2.81%	91.70%
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CO <sub>2</sub>	89.23	62.19	89.23	62.19	0.014	1.35%	93.04%
3.C.4	Direct N <sub>2</sub> O Emissions from managed soils	N <sub>2</sub> O	436.57	671.00	436.57	671.00	0.013	1.29%	94.34%
1.A.4	Other Sectors - Liquid Fuels	CO <sub>2</sub>	62.27	69.49	62.27	69.49	0.006	0.56%	94.90%
3.A.1.b-j	Enteric Fermentation - Other	CH <sub>4</sub>	93.09	124.48	93.09	124.48	0.006	0.54%	95.44%

There are 19 key categories in Armenia's GHG inventory - 14 of which have been identified with both level and trend assessments, 4 - with only level assessment and 1 more - with trend assessment.

Total value of emissions of key categories in 2017 is 9,735 Gg CO<sub>2</sub> eq. and they comprise 95.9% of overall net emissions.

## Uncertainty Assessment

The uncertainty assessment of Armenia's inventory covers all source categories and all direct greenhouse gases. The uncertainty has been assessed based on the level in 2017 GHG inventory data, as well as trend, where the base year was selected to be 2000.

The calculations' results revealed that the level of emissions uncertainty is within 17.9%, and the uncertainty of trend is 16.7%.

The highest contribution to variance by category in 2017 have *Direct and Indirect N<sub>2</sub>O Emissions from managed soils (3.C.4 and 3.C.5)*, CH<sub>4</sub> and N<sub>2</sub>O emissions for the use of natural gas in *Road Transportation (1.A.3.b)*, N<sub>2</sub>O emissions from *Wastewater*

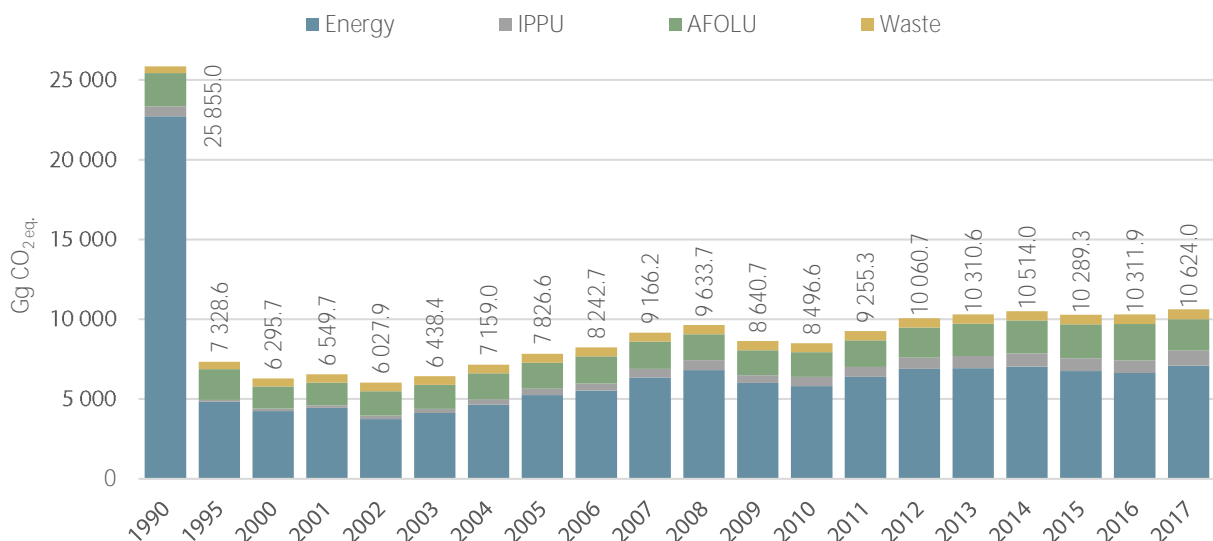
Out of 19 identified key categories, 12 are estimated using the higher tiers, including the 5 top key categories in both level and trend assessment. Overall, the net emissions from these 12 categories that have been estimated using higher tiers comprised 87.6% of total net national emissions in 2017.

*Treatment and Discharge (4.D)* and CH<sub>4</sub> emissions from *Solid Waste Disposal (4.A)*. The highest contributors in the uncertainty of trend have CH<sub>4</sub> and N<sub>2</sub>O emissions for the use of natural gas in *Road Transportation (1.A.3.b)*, CH<sub>4</sub> emissions from *Solid Waste Disposal (4.A)*, *Direct N<sub>2</sub>O Emissions from managed soils (3.C.4)* and HFCs emissions from *Refrigeration and Air conditioning (2.F.1)*.

As it can be seen, in all cases the highest uncertainties are related to non-CO<sub>2</sub> emissions. For CO<sub>2</sub> emissions, the categories with highest uncertainty contribution both in level and trend are the liquid fuel use in *Road Transportation (1.A.3.b)* and *Forest Land Remaining Forest Land (3.B.1.a)*.

## 2.4 Greenhouse Gas Emissions Trends

Figure 2.3 below provides greenhouse gas emissions trend by sectors for 1990-2017 (without *Forestry and Other Land Use*).



**Figure 2.3 1990-2017 greenhouse gas emissions by sectors (without *Forestry and Other Land Use*), Gg CO<sub>2</sub> eq.**

The Figure 2.3 shows contribution of the sectors to the total GHG emissions and highlights the absolute predominance of energy-related emissions.

As a whole, Armenia's total GHG emissions in 2017 decreased by nearly 59% (15,231Gg) compared to 1990, which was largely due to the decrease of Energy sector emissions, while 2017 emissions are 69% above 2000-year level.

Emissions resulted from Energy sector have varied considerably due to changes in electricity exports and production of electricity by natural gas fired thermal power plants. This variation has been the principal feature of the trend of CO<sub>2</sub> emissions from Energy sector since 2010.

In addition, Energy sector emissions are influenced each year by the economic situation in the country's energy intensive industries, the weather conditions and the volumes of energy produced by hydro-power plants. Thus, increase of Energy sector emissions in 2017 compared with those in 2016 is due to GDP growth in 2017 and cold winter.

In industrial processes the most significant emission sources were CO<sub>2</sub> emissions generated in cement production. A small amount of CO<sub>2</sub> emissions was also generated in lime and glass production, as well as from lubricant and paraffin wax use. Emissions caused by the industrial processes are mostly affected by the economic situation in the country. Total CO<sub>2</sub> emissions from industrial processes decreased markedly in the early 1990s when a number of factories shut down their operations. Similarly, after the decline of GHG emissions from IPPU sector in 2009 because of the economic recession, which resulted in the decrease of construction volumes and, consequently, cement production, in 2010 the construction volumes and cement production increased leading to the increase of GHG emissions. Increase of CO<sub>2</sub> emissions in 2017

compared to those in 2016 resulted from the growth of construction volumes as well. The increase in IPPU sector emissions over the last decade is primarily due to the increase of F-gases' emissions. Fluorinated gases, or F-gases, form a category of their own under industrial processes and accounted for roughly 6.5% of total national greenhouse gas emissions and over than 72% of the greenhouse gas emissions of IPPU Sector in 2017. In the period from 2010 to 2017, the biggest change occurred in F-gases emissions, which increased 2.6 times mainly due to the wide use of F-gases in refrigeration and cooling devices.

The decline in emissions in AFOLU sector in the 1990s was due to the liquidation of state-owned livestock farms which led to a sharp reduction in livestock and, accordingly, to a continuing reduction in emissions until 2000.

The increase in AFOLU sector emissions since 2000 (except for the period of economic crisis in 2009-2010), was due primarily to increase in livestock populations and increase in emissions from managed soils due to use of fertilizers.

The share of Waste sector emissions in the country's total emissions is relatively stable. Waste sector emissions accounted for 5.8% of the country's total emissions in 2017. During 2000-2017, Waste sector emissions increased by about 21% due to the growth in methane emissions from solid waste disposal because of high inertia and cumulative effect of organic matter decomposition process in anaerobic conditions.

Table 2.5 provides summary information of inventories for previous submission years from 1990 to 2017.

Total emissions in 2017 were 3% higher than those in 2016, approximately 59% (15,231 Gg CO<sub>2</sub> eq.) below the 1990 emissions level and about 69% higher than 2000 emissions level.

**Table 2.5 Greenhouse gas emissions by sectors from 1990 to 2017, Gg CO<sub>2</sub> eq.**

Sector	1990	1995	2000	2005	2010	2012	2014	2016	2017	2017 emission change (%) compared to		
										1990 levels	2000 levels	2016 levels
Energy	22,719.4	4,819.1	4,255.1	5,252.6	5,809.6	6,891.8	7,041.5	6,623.4	7,087.4	-68.8	66.56	7.0
Industrial Processes and Product Use	631.2	122.7	152.9	395.1	587.2	712.6	815.1	796.2	950.5	50.6	521.9	19.4
AFOLU (without Forestry and Other Land Use)	2,085.7	1,932.3	1,374	1,621.6	1,534.9	1,874.9	2,058.8	2,283.6	1,965.4	-5.8	43.1	-13.9
Waste	418.8	454.5	513.8	557.4	564.8	581.4	598.7	608.7	620.7	48.2	20.8	2.0
<b>Total Emissions</b> (without Forestry and Other Land Use)	<b>25,855</b>	<b>7,328.6</b>	<b>6295.8</b>	<b>7,826.6</b>	<b>8,496.6</b>	<b>10,060.7</b>	<b>10,514</b>	<b>10,311.9</b>	<b>10,624</b>	<b>-58.9</b>	<b>68.8</b>	<b>3.0</b>
Forestry and Other Land Use	-736.9	-514.4	-467.8	-523.7	-550.1	-510.1	-476.0	-488.0	-470.6	-36.1	0.6	-3.6
<b>Total Net Emissions</b>	<b>25,118.1</b>	<b>6,814.2</b>	<b>5,828.0</b>	<b>7,302.9</b>	<b>7,946.5</b>	<b>9,550.7</b>	<b>10,038.0</b>	<b>9,823.9</b>	<b>10,153.5</b>	<b>-59.6</b>	<b>74.2</b>	<b>3.4</b>

## 2.5 Greenhouse Gas Emissions by Sectors

### 2.5.1 Energy

The Energy sector is by far the biggest source of GHG emissions in the country - in 2017 its share of the total greenhouse gas emissions was 67% (7,087.4 Gg CO<sub>2</sub> eq.). The Energy sector emissions in 2017 made 31.2% of 1990 emissions' level and were 7.0% higher than in 2016.

Emissions from the Energy sector consist of two main categories: fossil fuel combustion and fugitive emissions from natural gas. The majority of the sector's emissions (77%) results from fossil fuel combustion.

The Energy sector is mainly responsible for carbon dioxide emissions - it produced over 95% of all carbon dioxide emissions, because of high emissions volume from thermal power plants, road transportation and residential sector. Methane emissions are also mostly from the Energy sector (about 52% of all methane emissions) due to the fugitive emissions from the natural gas system.

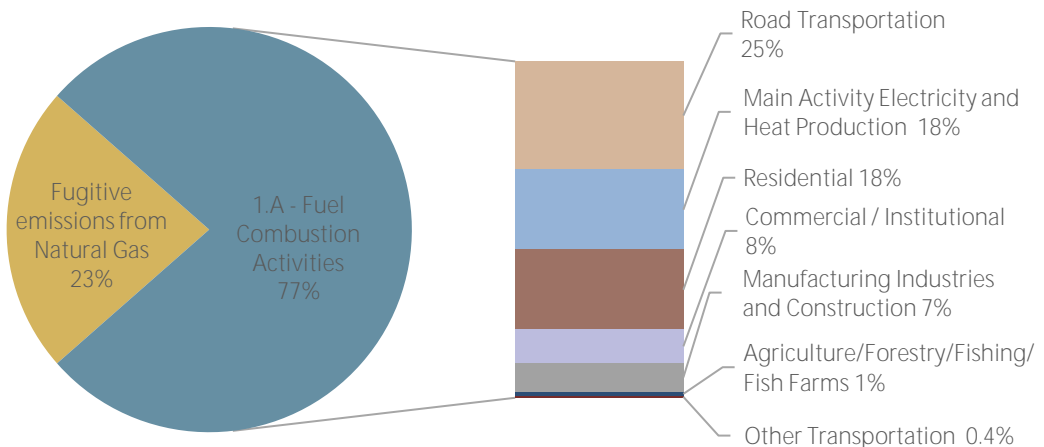
Armenia has no domestic resources of fossil fuel and imports all of its oil and gas. Vast majority of natural gas is imported from Russia - nearly 84% in 2017. Therefore, there is an urgent need for Armenia to increase its indigenous energy production, improve transmission infrastructure and reduce its dependence upon external suppliers.

Armenia relies on electricity and gas to meet most of its energy consumption needs. Imported natural gas predominates in total primary energy supply in Armenia accounting for 61% of Armenia's TPES and 85% of the fossil fuel (including jet fuel) consumption in 2017.

Over 83% of CO<sub>2</sub> emissions from fuel combustion (without international bunker) in 2017 originated from natural gas. This is due to a very high gas deliverability level in the country - 96% and widespread use of natural gas for heating and cooking purposes, as it is less expensive than electricity, as well as widespread use of natural gas in transport as it is less expensive than gasoline.

The main power generation capacities in Armenia are nuclear power plant, natural gas consumed thermal power plants (including small cogeneration units), large hydropower plants, as well as small renewables (small hydro, wind and solar power plants), which provided 33.7%, 18.1%, 37.0% and 11.1% of total electricity generation in 2017, respectively. As of 2017, renewable energy consisted mainly of hydropower (small to large HPPs) however, in recent years solar energy has been growing rapidly.

The contribution of each source to the total of the sector is presented in Figure 2.4.



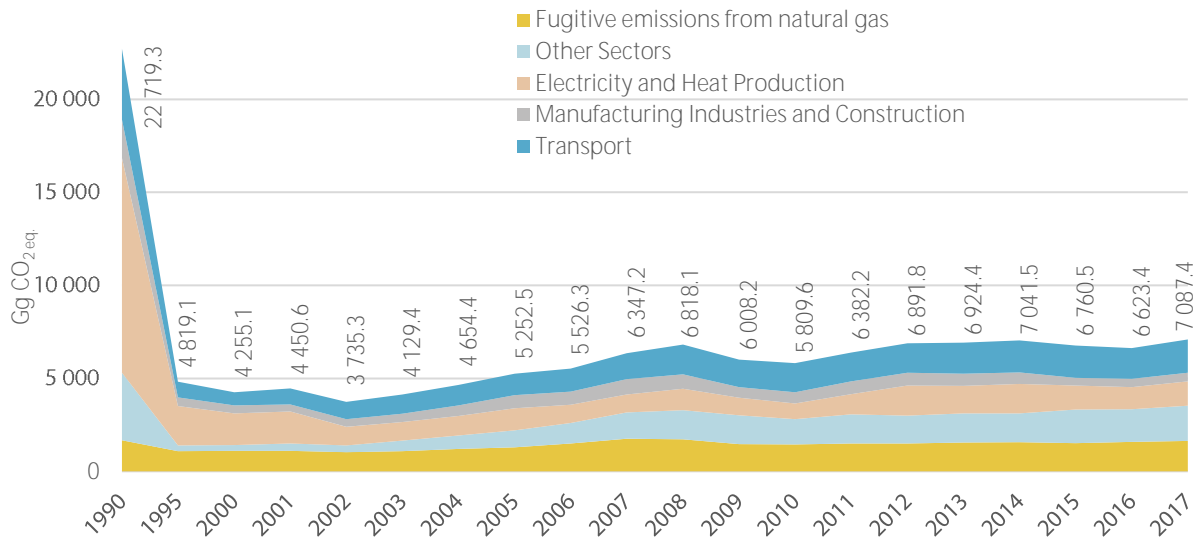
**Figure 2.4 Greenhouse gas emissions by sources in Energy Sector in 2017, %**

Figure 2.4 shows that road transport, fugitive emissions, electricity production and households are the leading sources of GHG emissions within the sector.

Road transport generated 24.8% of the Energy sector emissions in 2017, other significant emission source in Energy sector was fugitive emissions of natural gas, share of which in 2017 was slightly less - 23.0%. Emissions attributable to

electricity production and energy use by households accounted to 18.3% each, emissions from the fuels used by Commercial/Institutional category and different industries made 7.6% and 6.6% correspondingly, while emissions from Off-road Vehicles and Machinery in agriculture accounted only for 1%.

Figure 2.5 shows the complete time series for Energy sector.



**Figure 2.5 Greenhouse gas emissions in the Energy sector, 1990-2017, Gg CO<sub>2</sub> eq.**

Energy sector emissions have decreased by 3.2 times compared to the year 1990 while Total Primary Energy Supply (TPES) decreased by 2.4 times, which is an evidence of low-carbon development trends in Armenia. Key factors for such trend are the structural changes in economy towards the services sector and decreased share of energy intensive industries, use of less carbon-intense fuel (switch from coal and mazut to natural gas for energy production and in transport - from diesel and gasoline to natural gas), recommissioning of Armenia's Nuclear Power Plant, increasing share of renewable sources (strongest growth of the small hydropower plants), energy efficiency.

The increase of Energy sector emissions since 2000 (except for 2009-2010) amounts to nearly 67% due to economic growth, leading to the growth in traffic volume, which resulted in road transport emissions' growth (during 2000-2017 road transport emissions have increased by more than 150%), improved household

living conditions resulted in the wide use of natural gas for space heating (during 2004-2017, emissions attributable to energy used by households increased over fivefold) and increased production of electricity by natural gas fired thermal power plants.

In 2009, the financial and economic crisis affected the energy consumption, however, since 2011 emissions increased again because of economic recovery.

Emissions resulted from Energy sector have varied considerably due to changes in electricity exports and production of electricity by natural gas fired thermal power plants. Thus, the sharp increase of GHG emissions from Energy sector in 2012 in comparison with 2010 was caused by a high export growth met by thermal power plants (thermal power plants generation in 2012 has been increased by 135%, in comparison with 2010). This variation has been the principal feature of the trend of CO<sub>2</sub> emissions from Energy sector since 2010.



## 2.5.2 Industrial Processes and Product Use

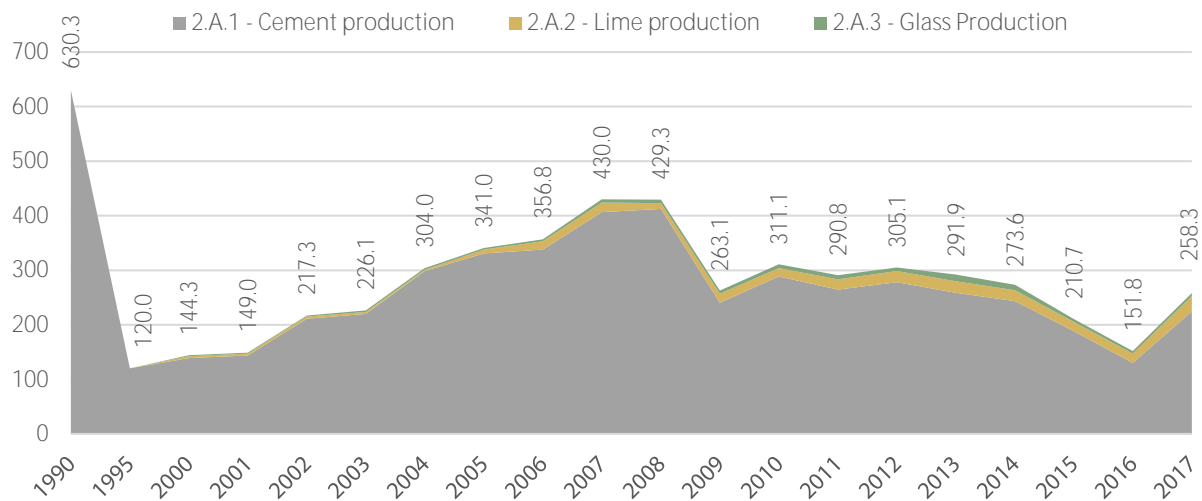
Emissions from this sector include non-energy related CO<sub>2</sub> emissions from *Mineral Industry* - cement, lime and glass production, CO<sub>2</sub> emissions generated from lubricant and paraffin use, emissions of F-gases (HFCs) from refrigeration, air conditioning and other product use, as well as emissions of SF<sub>6</sub> from use of electrical equipment.

Emissions from this sector include SO<sub>2</sub> emissions from metal industry, NMVOC emissions from solvent use, asphalt production and Food and Beverage industry as well.

Emissions from the IPPU sector amounted to 950.5 Gg CO<sub>2</sub> eq. in 2017, making up

approximately 8.9% of Armenia's total greenhouse gas emissions.

CO<sub>2</sub> emissions from IPPU sector made about 4.7% of total carbon dioxide emissions in 2017. The prevailing part of CO<sub>2</sub> emissions were generated in Mineral Industry - 258.3 Gg CO<sub>2</sub>, while CO<sub>2</sub> emissions generated from lubricant use and paraffin use were much smaller - 4.24 Gg CO<sub>2</sub>. The most significant CO<sub>2</sub> emissions' source was cement production (224.55 Gg CO<sub>2</sub>), which accounted for 23.6% of the emissions from the sector and 2.1% of Armenia's total emissions.



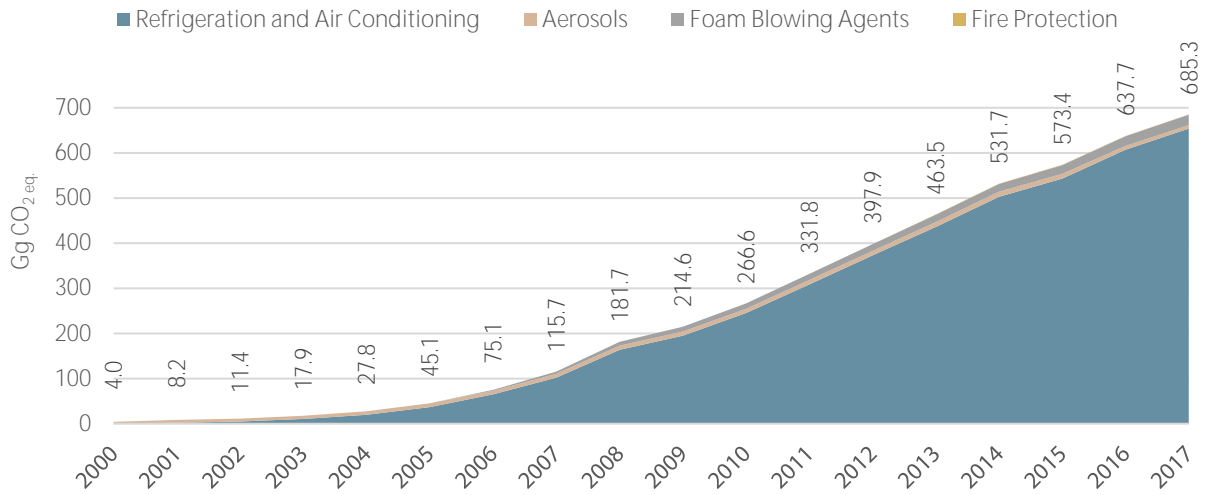
**Figure 2.6 CO<sub>2</sub> emissions from *Mineral Industry***

Total CO<sub>2</sub> emissions from industrial processes decreased markedly in the early 1990s when several factories shut down their operations. Similarly, after the decline of GHG emissions from IPPU sector in 2009 because of the economic recession, which resulted in the decrease of construction volumes and, consequently, cement production, in 2010 the construction volumes and cement production increased leading to the increase of GHG emissions. Increase of CO<sub>2</sub> emissions in 2017 compared to those in 2016 resulted from the growth of construction volumes as well.

Fluorinated greenhouse gases or F-gases form a category of their own under IPPU sector.

F-gases emissions made 687.9 Gg CO<sub>2</sub> eq. with prevailing share - 685.3 Gg CO<sub>2</sub> eq. from *Product Uses as Substitutes for Ozone Depleting Substances*, while SF<sub>6</sub> emissions from *Use of Electrical Equipment* were negligible - only 2.6 Gg CO<sub>2</sub> eq.

Emissions of HFCs from *Product uses as Substitutes for Ozone Depleting Substances* and SF<sub>6</sub> accounted for roughly 6.5% of total national greenhouse gas emissions and nearly 72% of the greenhouse gas emissions of IPPU sector in 2017. HFCs emissions, which are caused by refrigeration systems, predominate in the overall picture of HFCs emissions with the share of 95.4% in 2017. The share of emissions from other applications is about 4.6% altogether.



**Figure 2.7 HFCs emissions by applications, Gg CO<sub>2</sub> eq.**

HFCs emissions have grown continuously over the last decade – in the period from 2006 to 2017 they increased ninefold. HFCs have been used to replace ozone

depleting compounds in many refrigeration and cooling devices and applications, which is the main reason for the increase in HFCs.

### 2.5.3 Agriculture, Forestry and Other Land Use

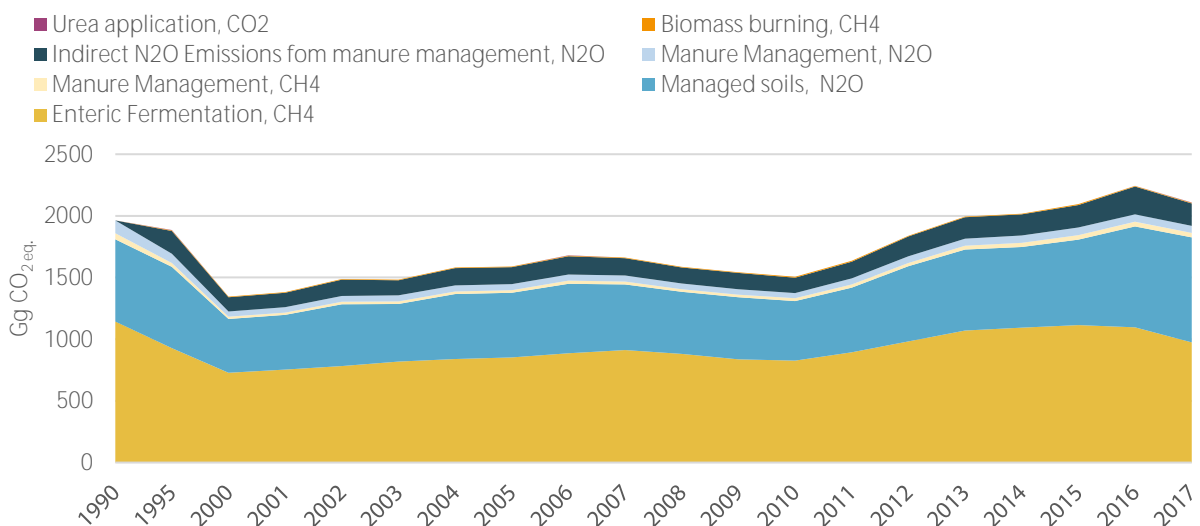
#### Agriculture

In 2017 agricultural emissions (3A and 3C categories) amounted to 1965.4 Gg CO<sub>2</sub> eq. (18.5% of total emissions) - a decrease of about 14% compared to the previous year.

Emissions from the Agriculture sector include methane (CH<sub>4</sub>) emissions from enteric fermentation of domestic livestock, manure management and biomass burning, nitrous oxide (N<sub>2</sub>O) emissions from manure management, biomass burning and from managed soils, as well as CO<sub>2</sub> emissions from urea application.

Of the total agricultural emissions, CH<sub>4</sub> emissions from enteric fermentation accounted for 49.5% and from manure management 1.8%, while N<sub>2</sub>O emissions from manure management (3A2 and 3C6) accounted for 4.8% and from soils - 43.4%.

The prevailing part (87%) of CH<sub>4</sub> emissions from enteric fermentation are generated by cattle while the prevailing part of N<sub>2</sub>O emissions - about 90%, are from soils.



**Figure 2.8 Greenhouse gas emissions in Agriculture, 1990-2017, Gg CO<sub>2</sub> eq.**

Reduced agricultural emissions during 1990 - 2000 was caused by structural changes in agriculture, which led to a decrease in the size of farms and in the numbers of livestock. The significant increase in agricultural emissions since 2000 was due primarily to the increase in

livestock population and increase in emissions from managed soils due to use of fertilizers. The decrease of agricultural emissions in 2017 compared to those in 2016 was due to decrease in the number of cattle.

**Forestry and Other Land Use (*Land* category)**

Armenia reports both greenhouse gas emissions and removals in *Land* category. Changes in carbon stocks in six land use categories covering the whole of Armenia are reported in this category.

In 2017, as in the previous years, *Land* category as a whole acted as a CO<sub>2</sub> sink: the net removals were -470.6 Gg CO<sub>2</sub> eq. Armenia’s largest carbon sinks are the forests (-530.445).

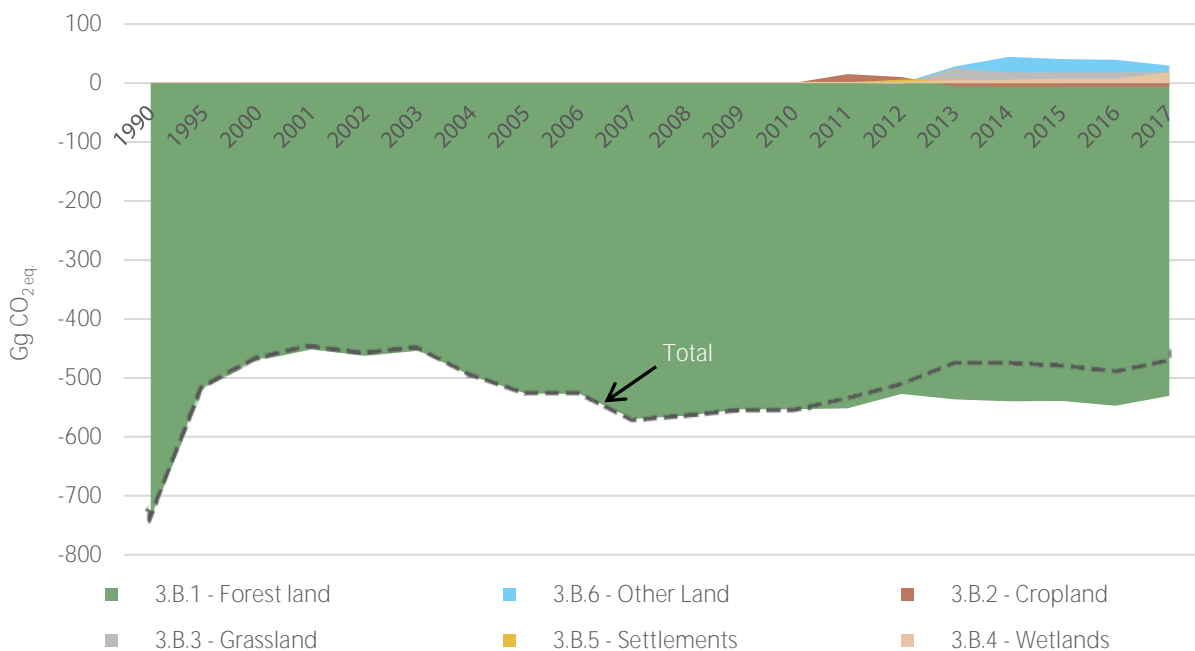
The prevailing part of annual carbon loss is caused by harvested fuelwood. Energy crisis of the 1990s resulted in a widespread harvesting of trees and economically undesirable change in the tree species i.e., high-value species (beech, oak, pine) have been replaced with those of low-productivity

(mostly stump-sprig hornbeam, aspen, etc.). However, recently there is a trend that beech, pine and partially oak become dominate in tree species.

In general, carbon absorption by forests is relatively constant in recent years.

Even though the *Land* category has clearly been a net carbon sink, it also produces some emissions. The largest emissions come from *Other land* (29.63 Gg CO<sub>2</sub>) as well as from *Grassland* and *Wetlands* categories (about 18 Gg CO<sub>2</sub> from each category).

The trend in emissions and removals from the *Land* category is presented in Figure 2.9.



**Figure 2.9 GHG Emissions and Removals from *Forestry and Other Land Use* category, Gg CO<sub>2</sub> eq.**

**2.5.4 Waste**

CH<sub>4</sub> emissions from landfills, CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions from the combustion of waste and CH<sub>4</sub> and N<sub>2</sub>O emissions from

wastewater treatment and discharge are reported under the Waste sector.

The Waste sector emissions amounted to 620.7 Gg CO<sub>2</sub> eq. in 2014, which accounts for approximately 5.84% of Armenia's total emissions. Landfill emissions accounted for 68.7% of all Waste sector emissions (4% of the country's total emissions), while

emissions from the combustion of waste are insignificant and accounted for 3.33 %. The emissions from wastewater treatment accounted for 28% of the Waste sector emissions in 2017.

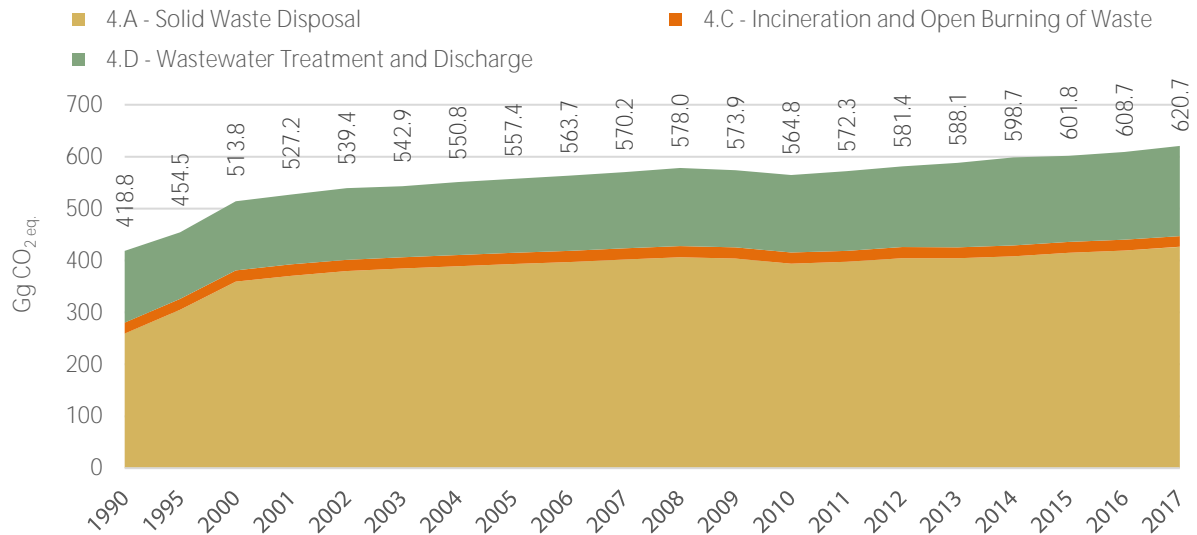


Figure 2.10 Greenhouse gas emissions in Waste sector, 1990-2017, Gg CO<sub>2</sub> eq.

## 2.6 National Inventory Arrangements

Since the ratification of UNFCCC, Government of Armenia once every five years approves a list of measures for implementing the country's commitments under international environmental conventions, including the UNFCCC, as well as assigns responsible agencies.

The list of measures to be implemented during 2017-2021 to fulfill obligations and provisions arising from the UNFCCC and Paris Agreement, including development of GHG Inventories every 2 years was approved by Government Protocol Decree N 49-8 of December 8, 2016.

The Ministry of Environment is the statutory entity responsible for the development and implementation of state policy addressing climate change issues and is responsible for fulfilling commitments under UNFCCC, including development of national communications, biennial update reports and GHG Inventories.

National climate change policies and actions are coordinated by the *Inter-agency*

*Coordinating Council for Implementation of Requirements and Provision of the UN Framework Convention on Climate Change*, which was established in 2012 by the Prime Minister's Decree. The Council has the authority to coordinate reporting on climate change and ensure coherent policies for achievement of Armenia's commitments under UNFCCC and is the decision-making body that approves the final drafts such as the national GHG inventory. The *Inter-agency Council* is an important established component of the National Inventory Arrangements.

The United Nations Development Programme (UNDP) through its Climate Change Program supports the Ministry of Environment, as an authorized national entity, in fulfilling the country's obligations under UNFCCC. The support includes the preparation of national communications, biennial update reports and GHG inventories.



# CHAPTER 3

## MITIGATION ACTIONS AND THEIR EFFECTS



This chapter provides information on climate change mitigation policies and measures implemented or ongoing in different sectors in RA in 2017-2019, as well as planned actions from the most recent strategy papers.

Considering that Energy is a strategic sector for the country in achieving economic growth and national security and the largest emitter of GHGs with the highest mitigation potential, this chapter also presents projections of Armenia's greenhouse gas emissions in the Energy sector up to 2030. These projections allow to assess Energy sector contribution to meeting the country's objectives under the NDC and are critical for evaluating realistic target for 2030 GHG emissions in 2020 NDC update.

Since Armenia lacks domestic industrial-scale fossil fuel resources, dependence on imported fuel supply makes development and expansion of economically viable and technically available renewable energy

sources, development of nuclear energy, promotion of energy efficiency, diversification of fuel supply chains key priorities for the sector development. Armenia adopted several policies and action plans aimed at development of the Energy sector while improving energy security and achieving energy independence.

The mitigation actions and projections of Armenia's greenhouse gas emissions for Energy sector described in this chapter are based on the main provisions of the recently adopted (2021) strategy papers on the Energy sector development, namely "The Republic of Armenia Energy Sector Development Strategic Program (till 2040)" (hereinafter referred to as the Strategy) and "Action Plan to Ensure the Implementation of the Republic of Armenia Energy Sector Development Strategic Program (till 2040)" (hereinafter referred to as the Action Plan).

### 3.1 Mitigation actions and their effects

The information on the mitigation actions implemented and ongoing during 2017-2019 has been obtained from the RA state agencies, private sector, international financial institutions and non-government organizations in response to the enquiry of the Ministry of Environment. The information on planned measures in Energy Sector is derived from the Strategy and Action Plan.

It should be noted that data collection and quality control of mitigation measures that are being implemented in the country are the main challenge faced while developing BURs, as these measures are not coordinated and there are risks of overlooking mitigation actions or double counting reductions. To address these

risks, quality control procedures have been performed, which included the analysis of obtained data and their cross-checking using the publicly available data, as well as assessing the progress of those mitigation actions, which have been reported in the BUR2. These are followed by discussions with the data providers and clarifying data as needed.

Table 3.1 describes the implemented, ongoing, as well as planned mitigation actions in different sectors, while Table 3.2 describes possible additional measures in Energy sector, which provide more ambitious development of renewable energy sources and enhanced implementation of energy efficiency measures.



**Table 3.1 Implemented, ongoing and planned mitigation actions and their effects by Sectors**

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implemen- tation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>Energy (generation side and distribution networks)</b>					
<b>Coverage:</b> CO <sub>2</sub> , CH <sub>4</sub> reduction through the increased share of renewables in power generation mix and implementation of the energy efficiency measures on generation side and in distribution networks					
<b>Methodology:</b> The impact assessment was carried out using the LEAP-Armenia software by calculating the reduction of greenhouse gas emissions from natural gas combustion and associated reduction of natural gas fugitive emissions due to reduced generation at thermal power plants					
<b>Nature:</b> Legislative, regulatory, technology					
<b>Utility-Scale Solar Power Plants</b>					
<b>Name of the action: Construction of medium utility-scale solar PV power plants</b>					
<b>Coordination/Support/Financing:</b> R2E2 with the financial support of EBRD and WB, private investors.					
<p>According to the Strategy and Action Plan, medium utility-scale solar power plants with total capacity of 175 MW will be constructed by the end of 2024. It includes:</p> <ul style="list-style-type: none"> <li>• PV “Masrik-1”, with a peak capacity of 55 MW (about 110 GWh of annually produced electricity) in 2022;</li> <li>• Additional solar PVs with total capacity of 120 MW will be constructed by the end of 2024 (about 192 GWh of annually produced electricity).</li> </ul>	<p>The quantitative goal is to install 55 MW of utility-scale PV by 2022 and additional 120 MW by 2024.</p> <p>The progress indicator: installed capacity of medium utility-scale solar PV.</p>	<b>Ongoing</b>	<p>The tariff is based on the proposed lowest tariff resulted from international competition. For Masrik-1 an international competition was held, which was won by the consortium of Dutch Fotowatio Renewable Ventures, B.V. and Spanish FSL Solar.</p> <p>In 2018, the RA Government signed a state assistance agreement, providing the developer of Masrik-1 with an electricity production license.</p>	<p>The impact assessment assumes that 55MW is added to power system in 2020 and another 120 by 2024. In both cases they substitute natural gas-based electricity generation in thermal power plants.</p>	<p>Expected annual emission reduction in 2030: 166.1 Gg CO<sub>2</sub> eq. (60.5 Gg CO<sub>2</sub> eq. from Masrik-1, 105.6 Gg CO<sub>2</sub> eq. from additional 120 MWs of PVs).</p>
<b>Name of the action: Construction of the larger utility-scale solar PV power plants</b>					
<b>Coordination/Support/Financing:</b> Armenian National Interest Fund (ANIF), R2E2, private investors.					
<p>According to the Strategy and Action Plan construction of 2 Solar PVs with the capacity of 200 MW each is envisaged in 2023 and 2024.</p>	<p>The quantitative goal is to support the installation of 400 MW of larger utility-scale PVs by 2024.</p> <p>The progress indicator: installed capacity of large utility-scale solar PV.</p>	<b>Planned</b>	<p>Request for Qualification was announced in 2020 seeking private developers for a project to design, finance, build, own, and operate the first of considered 2 plants, which will be grid-connected 200 MW solar PV power plant called “Ayg-1”.</p>	<p>The impact assessment assumes that 200MW of solar capacity is added to power system in 2023 and another 200MW in 2024. In both cases they substitute electricity generation in thermal power plants.</p>	<p>Expected annual emission reduction after 2024: 352 Gg CO<sub>2</sub> eq. (176 Gg CO<sub>2</sub> eq. each)</p>

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>Name of the action: Commissioning of Solar PVs with capacity of up to 5 MW</b>					
<b>Coordination/Support/Financing:</b> Private investors					
According to the Strategy and Action Plan, the construction of solar PV power plants with an installed capacity of up to 5 MW (inclusively) will be supported through tariff policy and power purchase agreement.	The quantitative goal is to support the installation of the total of 315 MW of solar PV power plants with an installed capacity of up to 5 MW (inclusively) by 2030. The progress indicator: The total installed capacity of solar PV power plants with an installed capacity of up to 5 MW (inclusively)	<b>Ongoing</b> 2018-2029	As of October 1, 2020, licenses for production of electricity have been granted to 49 solar PVs with a capacity of up to 5 MW with the total installed capacity of 200 MW. As of December 1, 2020, 2 plants with total of 10 MW capacity have been already connected to the grid.	The impact assessment has been done assuming that PVs with the total capacity of 200 MW will be commissioned in 2022 and PVs with the total capacity of 315 MW will be commissioned in 2030. The generation of solar power plants substitute electricity generation in thermal power plants.	Expected annual emission reduction after 2022: 176 Gg CO <sub>2</sub> eq. and in 2029: 277 Gg CO <sub>2</sub> eq.
<b>Name of the action: Commissioning of Solar PVs with capacity of up to 1 MW</b>					
<b>Coordination/Support/Financing:</b> Private investors, KfW Bank which provided loans through Armenian commercial banks.					
Construction of solar PV power plants with an installed capacity of up to 1 MW (inclusively).	The construction of the solar PVs of this group was limited to a total capacity of 10 MW.	<b>Completed</b> 2017-2019	The licenses for production of electricity for these PVs were granted from November 2016 before November 1, 2018, inclusively. 12 solar PVs with the installed capacity of up to 1 MW each, and within the limits of total capacity of 10 MW, have been commissioned.	The impact assessment was done considering commissioning of 12 solar PVs with the total capacity of 10 MW in 2019.	Expected annual emission reduction in 2020: 9 Gg CO <sub>2</sub> eq.
<b>Hydro Power Plants</b>					
<b>Name of the action: Upgrade of the Contour Global (Vorotan) Hydro Power Plant</b>					
<b>Coordination/Support:</b> IFC, Contour Global (Vorotan) Hydropower Cascade					
<b>Financing:</b> IFC has arranged USD 140 mln financing package for Vorotan Hydropower Cascade					
The upgrade of Contour Global (Vorotan) Hydro Cascade to increase power generation	The quantitative goal was to achieve the annual electricity generation by Vorotan Cascade of up to 1,150 GWh. The progress indicators: The average annual electricity generation by Vorotan Cascade.	<b>Completed</b> 2018-2019	The upgrade of the plant was concluded in 2019 and the planned annual electricity generation has been achieved.	The assessment of the impact has been performed based on annual electricity generation of 1,150 GWh by the Vorotan Cascade.	Annual emission reduction in 2019: 105 Gg CO <sub>2</sub> eq.

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>Name of the action: Commissioning of small Hydro Power Plants (SHPPs)</b>					
<b>Coordination/Support/Financing:</b> Private investors; EBRD and KfW Bank (through "German-Armenian Fund" RE Program) provided loans for lending through Armenian commercial banks.					
The objective of the action is to create the favorable conditions for SHPPs development. In 2016 the GoA approved the Hydro Energy Development Concept of the RA, which envisages commissioning of new SHPPs. The Energy Law supports the development of SHPPs through the Power Purchasing Agreement for the 15-year period.	Quantitative goal: To reach the total capacity of SHPPs of 430 MW by 2023. The progress indicators: The total capacity of SHPPs.	<b>Ongoing</b>	In 2017-2020, 16 SHPPs were commissioned with a total installed capacity of 44.5 MW and annual generation of 119.2 GWh. As of April 1, 2020, the total capacity of the SHPPs was 374.4 MW, while SHPPs with capacity of 60 MW and annual generation of 203.4 GWh are under construction.	Assessment was carried out considering the actual installed capacities of the SHPPs - 374.4 MW in 2020 and assuming that by 2023 the total capacity of SHPPs will reach 430 MW.	Expected annual emission reduction from 2023: 253 Gg CO <sub>2</sub> eq.
<b>Distribution Networks</b>					
<b>Name of the action: Upgrade of distribution networks implemented by the Electric Networks of Armenia</b>					
<b>Coordination/Support:</b> Electric Networks of Armenia					
<b>Financing:</b> ENA will invest in further modernization of the grid over USD 750 mln until 2027. EBRD and ADB provided loans to ENA of USD 80 mln each to finance a 5-year USD 750 mln investment programme for the modernization of the distribution network.					
Reduction of the ENA losses through upgrading the distribution networks.	Reduction of distribution losses to 6.4% in 2027 (ENA 2016-2027 Investment program). Progress Indicators: electricity losses in distribution networks.	<b>Ongoing</b> 2016-2027	In 2017 the losses were 8.6%, in 2018 - 8.0%, in 2019 - 7.3% (PSRC data).	The assessment of the impact has been performed assuming reduction of losses to 6.4% by 2028.	Expected emission reduction in 2028: 298 Gg CO <sub>2</sub> eq.
<b>Energy (demand side)</b>					
<b>Coverage:</b> CO <sub>2</sub> and CH <sub>4</sub> emissions reduction through implementation of energy efficiency/energy saving measures and introduction of the new renewable energy sources					
<b>Methodology:</b> The impact assessment was carried out using the LEAP-Armenia software by calculating the reduction of greenhouse gas emissions, including the associated reduction of fugitive emissions, resulted from the natural gas and electricity savings through implementation of mitigation actions					
<b>Buildings</b>					
<b>Name of the action:</b> "De-risking and Scaling-up Investment in Energy Efficient Building Retrofits" UNDP-GCF project					
<b>Nature:</b> Combination of technology improvement, regulations, incentives and education					
<b>Coordination/Support/Implementing Partners:</b> Ministry of Environment, Ministry of Territorial Administration and Infrastructure, Yerevan Municipality, UNDP, GCF, European Investment Bank (EIB)					
<b>Financing:</b> USD 20 mln grant from the Green Climate Fund (GCF), Yerevan Municipality` AMD 8 mln dram, State subvention program					

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
The objective of the Project is to scale-up investment in energy efficiency building retrofits in Armenia, reduce the overall investment risk profile of energy efficiency building retrofits to encourage private sector investment and reduce fuel poverty.	The overall goal is to reduce the GHG emissions over the 20-year lifetime of the EE interventions: Direct impact - 1.4 mln t CO <sub>2</sub> eq. Indirect impact - 4.2 to 4.4 mln t CO <sub>2</sub> eq. Progress indicator: Energy savings in retrofitted buildings.	<b>Ongoing</b> 2017-2023	Energy audit in 46 kindergartens in Yerevan was implemented. As of 2019, two pilot projects on EE retrofitting resulted in 1.2 GWh annual savings.	Emissions reduction assessment was done considering energy savings in 2023 of both natural gas and electricity. Expected annual energy savings in 2023: 264.3 GWh/year (provided in the Project Document).	Expected annual emission reduction from direct impact in 2023: 100 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Yerevan Energy Efficiency in Public Buildings					
<b>Nature:</b> Technology improvement					
<b>Coordination/Support:</b> The project is implemented jointly by the European Investment Bank (EIB), E5P, Yerevan Municipality, the Green Climate Fund and the United Nations Development Programme (“De-risking and Scaling-up Investment in Energy Efficient Building Retrofit” Project).					
<b>Financing:</b> Total cost: EUR 15 mln EIB loan: EUR 7 mln, E5P grant: EUR 5 mln, Municipality of Yerevan own funds: EUR 2 mln, GCF mobilized by the UNDP: EUR 1 mln					
The objective of the project is to support the Municipality of Yerevan in implementing a rehabilitation programme involving energy efficiency and integration of renewable energy measures in public buildings.	In total about 147 buildings (primarily kindergartens) in Yerevan will benefit from increased energy efficiency and seismic measures. Among these, about 48 kindergartens will receive comprehensive EE retrofits and refurbishment of building envelope. Other EE measures, as well as on-site utilization of RE sources will be carried in remaining 99 other buildings. Progress indicator: Number of retrofitted buildings; Energy savings in retrofitted buildings.	<b>Ongoing</b> 2018-2022	Seismic surveys were completed in 30 buildings; Energy audits in 30 buildings were completed; Final designs of 10 kindergartens, together with technical expertise approval were provided to Municipality of Yerevan, the others are ongoing.	Emissions reductions assessment was done based on the projected energy savings (both thermal and electrical) for 147 buildings calculated using the assessments from the “Study on the selection of the buildings for the Energy Efficiency (EE) and Thermal Public Building Refurbishment Project in Yerevan”.	Expected annual emission reduction from 2022: 18.8 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Household Energy Efficiency Mortgage Loans					
<b>Nature:</b> EE promotion, technology improvement, financial mechanism					
<b>Coordination/Support:</b> Central Bank of Armenia, KfW, GAF, French Development Agency					
<b>Financing:</b> The Program is financed by the French Development Agency (USD 13.7 mln), technical assistance funding (EUR 1.5 mln) from the EU Neighbourhood Investment Facility (NIF) to Partner Financial Institutions (PFI), non-refundable grant funding from the EU NIF to borrowers and KfW financing through GAF in the frames of “Development of Sustainable Housing Market” (GAF-HF) loan program (4th phase) in the amount of EUR 20mln.					
<b>Implementing Partners:</b> National Mortgage Company					

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
To provide loans for on-lending to private households including Yerevan City and the regions of Armenia to finance energy efficiency investments in housing for low and middle-income families.	The quantitative goal is to provide loans to and achieve energy savings in approximately 3000 households. Progress indicators: number of beneficiaries, annual energy savings.	<b>Ongoing</b> 2014-2020	As of 2020, 1,348 households received EE loans in the frame of the French Development Agency financing and GAF has refinanced 1,103 (National Mortgage Company's Report, 2019).	Emission reductions were assessed based on technical estimates and information provided by NMC (2019 Report), considering natural gas savings resulted from EE investment in housing, which will lead to an average of 44% energy savings on demand side. Expected annual energy savings in 2020: 3.9 GWh.	Expected annual emission reduction in 2020: 1.1 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Investments for energy efficiency repair works and lighting in municipal buildings					
<b>Nature:</b> Technological improvement, energy efficiency					
<b>Coordination/Support/ Financing:</b> Yerevan Municipality, Administrative Districts; Total cost: EUR 6.09 mln					
The objective is the replacement of doors and windows, heating systems, and inefficient lamps in municipal buildings.	The quantitative goal is to achieve energy savings from repair works of 8-10%, and to achieve annual energy savings of 385 MWh in lighting. Progress indicators: annual energy savings in public buildings.	<b>Ongoing</b> 2013-2020	The annual energy savings achieved through implementation of lighting measures by 2019 equals to 178.6 MWh.	Emissions reduction assessment was done based on natural gas savings of 9,788 MWh/year and electricity savings of 385 MWh/year in 2020 provided in "Questionnaire for collection of data on implementation of Sustainable Energy Action Plan of Yerevan Municipality"	Expected annual emission reduction in 2020: 3.1 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Loan Mechanisms for Increasing Energy Efficiency in Multiapartment Buildings (MABs)					
<b>Nature:</b> Promotion, financial, technology					
<b>Coordination/Support/Financing:</b> Habitat for Humanity Armenia (HFHA), Yerevan Municipality, USAID. Total financing EUR 1.1 mln, including grants and loan.					
Habitat for Humanity Armenia (HFHA) has developed a model of providing loans for energy efficiency investments in condominiums.	The quantitative goal was the annual energy savings of 5,067 MWh starting from 2019. Progress indicators: Energy savings.	<b>Completed</b> 2013-2018	Loan mechanism was developed and applied; reconstruction /repair works have been implemented in 13 MABs; capacity-building activities were performed for increasing awareness on energy efficiency actions in MABs.	Emissions reduction assessment was done assuming the natural gas savings of 5,067 MWh, which was provided by the Project.	Expected annual emission reduction in 2020: 1.9 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Access to Renewable and Efficient Energy in Municipalities Vayk and Spitak (AREEM) Project					
<b>Nature:</b> Technology improvement, capacity building, incentives					
<b>Coordination/Support:</b> EU Delegation to Armenia, GoA					
<b>Financing:</b> Total cost: EUR 1.687 mln (EU contribution: EUR 1.35 mln, Spitak and Vayk municipalities: EUR 0.337 mln).					

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>Implementing Partners:</b> Spitak and Vayk municipalities in partnership with Habitat for Humanity Armenia Foundation					
Support the municipalities of Spitak and Vayk to develop and test replicable and efficient model(s) of energy savings through use of effective measures and renewable sources in residential buildings, incorporated with their Community Development Plans/or Sustainable Energy Action Plan (SEAPs) within the Covenant of Mayors (CoM) requirements.	Installations of solar PVs in Vayk and Spitak with total capacity about 86 kW, and implementation of energy saving measures in public and residential buildings. Progress indicators: installed solar capacity, Energy savings.	<b>Completed</b> 2014-2019	The solar PVs have been installed for 8 public consumers and EE activities have been carried out in residential buildings that entail at least 20% energy saving and improvement of comfort level.	Emissions reductions assessment was done based on annual energy saving of 1891.57 MWh and RE generation of 123.432 MWh (According to the assessment made by HFHA team). Emissions reduction from PVs have been included in assessment of "Autonomous power generators (up to 500 kW)".	Emission reduction from EE measures in 2019: 0.7 Gg CO <sub>2</sub> eq. and from RE measures: 0.09 Gg CO <sub>2</sub> eq.
<b>Lighting</b>					
<b>Name of the action:</b> Supporting Communities of Armenia to Adopt and Implement Climate Smart Solutions UNDP-GEF					
<b>Nature:</b> Combination of technology, education, capacity building, financial mechanism, legislation					
<b>Coordination/Support:</b> UNDP, Yerevan Municipality					
<b>Financing:</b> Yerevan Municipality					
<b>Implementing Partners:</b> UNDP-GEF Project, Yerevan Municipality					
Cooperation continues between UNDP and Yerevan Municipality to introduce energy efficient lighting systems in the city. The partners used the accumulated resources of the revolving fund established in "Yerevan Municipal Illumination" CJSC of Yerevan Municipality in the framework of "Green Urban Lighting" UNDP-GEF project back in 2015.	Quantitative goal: Direct annual electricity savings of 3.1 GWh. Progress indicators: Energy savings.	<b>Ongoing</b> 2019–2020	Installation of total 3, 667 LED street luminaires replacing 4,256 existing HPS luminaires ensuring 2.496 GWh electricity savings annually.  The street lighting system efficiency is improved in average by 75%.	Emissions reduction assessment was done considering electricity savings provided by the Project.	Expected annual emission reduction since 2020: 1.7 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Green Urban Lighting					
<b>Nature:</b> Combination of technology, education, capacity building, financial mechanism, legislation					
<b>Coordination/Support:</b> MOE, UNDP, UNDP-GEF Project, Municipalities					
<b>Financing:</b> GEF: USD 1.6 mln, UNDP grant: USD 0.12 mln, co-financing from municipalities: USD 0.2 mln.					
<b>Implementing Partners:</b> MOE, Municipalities					
Promote energy efficiency in municipal lighting through demonstration projects	Direct annual electricity savings: 1.2 GWh from demo projects and 20 GWh from replication of demo projects via municipal programs.	<b>Completed</b> 2013-2019	The municipal minimum energy performance standard for lighting appliances has been adopted for public sector.	Emissions reduction assessment was done considering both direct annual electricity savings and indirect annual electricity	Expected annual emission reduction in 2030: 131.6 Gg CO <sub>2</sub> eq.



Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implemen- tation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
implementation, establishment of financial and institutional mechanisms for scaling up municipal EE lighting programs and policy instruments, educational and capacity building activities.	Indirect annual electricity savings: 125 GWh from the implementation of national lighting policy (Project document). Progress indicators: Energy savings.		Project also implemented several demonstration projects where the inefficient street lighting bulbs were replaced by efficient (LED) ones. A revolving fund was created, which financed other similar projects.  Annual electricity savings achieved in 2018 were: <ul style="list-style-type: none"> <li>• 1.564 GWh from demonstration projects.</li> <li>• 20.56 GWh from replication of demonstration projects</li> <li>• 188.2 GWh from the implementation of national lighting policy (Terminal evaluation of the Project).</li> </ul>	savings from implementation of national green lighting policy. Expected annual energy savings in 2030: 210.3 GWh, including both direct and indirect energy savings.	
<b>Name of the action:</b> Yerevan Street Lighting					
<b>Nature:</b> Technology improvement					
<b>Coordination/Support/Implementing Partners:</b> EBRD, E5P, Yerevan Municipality					
<b>Financing:</b> Total cost: EUR 6.6 mln (EBRD Loan: EUR 3.7 mln, E5P Grant: EUR 1.9 mln, additional technical assistance funds: EUR 1.0 mln).					
<b>Implementing Partners:</b> Yerevan Municipality					
The objective is to modernize 28 streets in the center of Yerevan by installing new energy efficient LED luminaries and a control and monitoring system, replacing and renovating poles, and replacing power cables.	To modernize 28 streets and achieve electricity savings of at least 2,084 MWh/year. Progress indicators: Energy savings.	<b>Ongoing</b> Work started in 2020	The funding has been acquired in 2015 and work started in 2020.	Energy saving assessment was done considering both 28 streets (pilot project) and the full-size project (the whole city of Yerevan). Emissions reduction assessment for 28 streets was done considering expected electricity savings in 2023 - 2,084 MWh/year provided by the EBRD and correspondingly, expected annual electricity saving of 43.2 GWh in 2026 for the full-size project.	Expected emission reduction for the full-size project (the whole city of Yerevan) in 2026: 27.6 Gg CO <sub>2</sub> eq.

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Gyumri Street Lighting					
<b>Nature:</b> Technology improvement					
<b>Coordination/Support:</b> EBRD, E5P, Gyumri Municipality					
<b>Financing:</b> Total cost: EUR 7.4 mln (EBRD Loan: EUR 4 mln, E5P grant: EUR 2 mln, TC funds: EUR 1.4 mln)					
<b>Implementing Partners:</b> Gyumri Municipality					
Replacing existing high-pressure mercury-based luminaries in city of Gyumri with modern energy efficient LED luminaries, upgrading the electrical supply cabling to protect and extend the lifetime of the LED lanterns, improve environmental standards.	To achieve the energy savings of 70% in public lighting system in City of Gyumri. Progress indicators: Energy savings.	<b>Ongoing</b> Work started in 2020	The necessary funds and a suitable consultant expected by mid of 2020.	Emission reduction assessment was done based on the projected electricity savings provided in the project document (1,698 MWh/year)	Emission reduction in 2024 (assuming project completion in 2024): 1.2 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> State subvention program of the RA Government in 2018-2019					
<b>Nature:</b> Incentives, financial, technology improvement, capacity building					
<b>Coordination/Support:</b> GoA, Communities					
<b>Financing:</b> GoA: EUR 2.26 mln, Communities: EUR 1.75 mln					
<b>Implementing Partners:</b> GoA, Communities					
Implies co-financing of part of the capital costs of implementation of municipal programs proposed by local authorities and approved by GoA including measures on street lighting upgrading and installation of renewable energy plants (solar PVs).	The goal is to prioritize capital investments in community projects that improve economic infrastructures and facilitate economic development in communities including EE measures and use of RE. Progress indicators: number of co-financed projects; savings achieved by co-financed projects.	<b>Ongoing</b> Project started in 2018	Installation of 11,443 LED luminaries and solar PVs with total capacity of 1.283 MW resulted in annual electricity savings of 8,656 MWh in 2020.	Emissions reduction assessment was done considering electricity savings resulted from improved efficiency and RE generation. Emissions reduction from PVs have been included in assessment of "Autonomous power generators (up to 500 kW)".	Emission reduction from EE in 2019: 4.9 Gg CO <sub>2</sub> eq. and from RE generation in 2019: 1.52 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Bright Border					
<b>Nature:</b> Energy efficient technology transfer					
<b>Coordination/Support/ Implementing Partners:</b> "Armenian Energy Agency" Foundation, public initiative					
<b>Financing:</b> Donations					
Promotion of energy efficient technologies, reduction of energy costs and market development	The goal is to install LED street-lights in all bordering communities. Progress indicators: number of LED lights installed in border communities.	<b>Ongoing</b> Project started in 2016	As of 2020 33,000 street LED luminaries have been installed in 30 bordering communities. Achieved energy savings: 4.3 GWh.	Emissions reduction assessment was done considering electricity savings provided by "Armenian Energy Agency" Foundation.	Expected annual emission reduction in 2020: 3.2 Gg CO <sub>2</sub> eq.

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implemen- tation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>Transport</b>					
<b>Name of the action:</b> Strategy program for the optimization of public transport (PT)					
<b>Nature:</b> Infrastructure development					
<b>Coordination/Support:</b> Yerevan Municipality, IFI					
<b>Financing:</b> EUR 17.2 mln					
<b>Implementing Partners:</b> "Yerevanproject" CJSC					
This activity implies PT vehicle stock renewal, management and technical optimization, modernization of the ticket system and schedules.	The goal is to develop new routes network based on principle of ruling out any overlapping routes and enabling to significantly reduce the number of vehicles.  Progress indicators: number of public transport routes, energy consumption in public transport.	<b>Ongoing</b> 2017-2021	New routes network is being developed by municipality.	Emissions reductions assessment was done based on the projected energy savings provided in "Monitoring Report of the Yerevan City SEAP", of 145.3 GWh/year by 2021.	Expected annual emission reduction in 2021: 41.8 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Re-equipment of public electric transport (trolleybuses) pool and infrastructure					
<b>Nature:</b> Infrastructure development					
<b>Coordination/Support:</b> Yerevan Municipality, EBRD					
<b>Financing:</b> EUR 28 mln					
<b>Implementing Partners:</b> "Yerevan electric transport" CJSC					
The measure was included in Yerevan's SEAP and aimed to improve the operation and infrastructure.	The goal was modernization of the trolleybus pool, renovation and modernization of the overhead contact system, modernization of traction substations, renovation and improvement of the cable network.  Progress indicators: performed activities	<b>Ongoing</b> 2017-2021	Renovation and modernization of the overhead contact system, and renovation and improvement of the cable network	Emissions reductions assessment was done based on the projected energy savings provided in "Monitoring Report of the Yerevan City SEAP" of 2.56 GWh/year in 2021.	Expected annual emission reduction in 2021: 1.9 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Re-equipment of public electric transport (Yerevan Metro)					
<b>Nature:</b> Infrastructure development					
<b>Coordination/Support:</b> YM, EBRD					
<b>Financing:</b> EUR 21 mln					
<b>Implementing Partners:</b> Yerevan Metro CJSC, government structures					
The measure was included in Yerevan's SEAP and aimed to improve the operation and re-equip Yerevan's Metro.	The goal is Construction of a drainage tunnel, modernization of 15 escalators, replacement of 6kW cable	<b>Ongoing</b> 2017-2022	The lighting system in the station halls has been equipped with energy-efficient lamps; Construction of a drainage	Emissions reductions assessment was done based on the projected energy savings provided in "Monitoring Report	Expected annual emission reduction in 2022: 2.6 Gg CO <sub>2</sub> eq.

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
	network, re-equipment of substations, modernization of the lighting system in the station halls by installation of energy-efficient lamps. Progress indicators: Activities performed for improving the operation of Yerevan's metro.		tunnel modernization of escalators, replacement of 6kW cable network and re-equipment of substations is ongoing.	of the Yerevan City SEAP": 3.73 GWh/year in 2022.	
<b>Name of the action:</b> Conversion of Yerevan public and private vehicles to Compressed natural gas (CNG)					
<b>Nature:</b> Infrastructure development					
<b>Coordination/Support/ Implementing Partners:</b> Yerevan Municipality					
<b>Financing:</b> Yerevan Municipality, private companies, other government structures					
Activity focuses on promoting the conversion of Yerevan public and private vehicles to CNG through allocation of sites for gas refueling stations in Yerevan administrative districts, definition of safety requirements, etc.	The goal of the project is to switch 73 buses and 25 official cars from diesel to CNG. Progress indicators: number of CNG busses and official cars.	<b>Completed</b> 2017-2020	73 buses and 25 official cars has been reequipped to run on CNG.	Emissions reductions assessment was done based on switch of 73 buses from diesel to CNG provided in "Monitoring Report of the Yerevan City SEAP".	Expected annual emission reduction in 2021: 2.6 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Improvement of road infrastructure					
<b>Nature:</b> Infrastructure development					
<b>Coordination/Support/ Implementing Partners:</b> Yerevan Municipality, ADB, Sustainable Urban Development Investment Program (SUDIP)					
<b>Financing:</b> EUR 82.8 mln (total budget including ADB's loan)					
The program is focusing on enlargement of the road and street network, construction of road junctions on various levels, construction of new bypass roads in Yerevan.	The goal of the program is reducing traffic congestion in the city center; improvement of the road and street network of the city center; and arrangement of primary roads bypassing the City of Yerevan. Progress indicators: Traffic activity in city center, number of rehabilitated and constructed new roads.	<b>Ongoing</b> 2017-2021	The construction of the Davitashen-Ashtarak road has been completed, the road has been in operation since December 2018. Currently, the construction of the Babajanyan-Ashtarak road is underway, planned to be completed in 2020. Argavand-Shirak road section: a new tender for the construction has been announced. The issue of choosing the final version of the project for Arshakunyats-	Emissions reductions assessment was done based on the projected energy savings provided in "Monitoring Report of the Yerevan City SEAP", which assumes that the improvements in road infrastructure will lead to energy savings of 211.14 GWh/year in 2021.	Expected annual emission reduction in 2021: 55.6 Gg CO <sub>2</sub> eq.

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
			Garegin Nzhdeh road junction - is currently being discussed.		
<b>Name of the action:</b> Optimization of municipal transport and improvement of management efficiency (including in terms of garbage-removal and sanitary cleaning vehicles and machinery)					
<b>Nature:</b> Infrastructure development					
<b>Coordination/Support:</b> Yerevan Municipality					
<b>Financing:</b> EUR 10 mln					
Optimization of municipal transport and improvement of management efficiency (including in terms of garbage-removal and sanitary cleaning vehicles and machinery)	The goal is to develop new mechanisms for garbage collections and make city's sanitary cleaning more effective. Progress indicators: Developed standards and control mechanisms.	<b>Completed</b> 2017-2020	New standards and control mechanisms have been implemented to make garbage collection more effective. 140 new garbage vehicles have been purchased.	Emissions reductions assessment was done based on the projected energy savings provided in "Monitoring Report of the Yerevan City SEAP" of 7.88 GWh/year from 2020.	Expected annual emission reduction in 2020: 2.2 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Yerevan Bus Project					
<b>Nature:</b> Infrastructure development					
<b>Coordination/Support:</b> EBRD					
<b>Financing:</b> EUR 25 mln sovereign loan					
<b>Implementing Partners:</b> Yerevan municipality					
"Yerevan Bus Project" will finance the purchase of new modern 12-metre low-floor compressed natural gas ("CNG") buses. The project is part of a broader programme aiming to assist the city to reform its public transport system by financing the renewal of its bus fleet in anticipation of the restructuring of the bus network.	Replacement of current 1,922 buses with 845 buses. Progress indicators: number of replaced busses	<b>Start in 2020</b>	The funding has been acquired and the project will start in 2020.	Emission reduction assessment is done based on the assessment of GHG emission reduction from the replacement of the existing municipal transport fleet with new CNG buses done in the frames of the "Yerevan Green City Action Plan ("GCAP")", including replacement of current 1,922 buses with 845 buses (including reserve of 15%).	Expected annual emission reduction in 2020: 56.3 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Promoting fuel switching to electricity in transport					
<b>Nature:</b> Promotion, technology, regulatory					
<b>Coordination/Support:</b> GoA					
To promote the acquisition and use of electric vehicles in the country by creating favorable conditions through the preferential tax regime.	To goal is to increase the share of electric vehicles in the country. Progress indicators: number of electric vehicles.	<b>Ongoing</b>	In 2019 145 electric vehicles, 523 motorcycle and mopeds were imported in Armenia.	GHG emissions assessment has been done assuming that the same growth trends of electric vehicles will continue in the	Emission reduction in 2030: 3.1 Gg CO <sub>2</sub> eq.



Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
			For comparison: in 2018 there were only 12 electric vehicles in the country.	upcoming years (1475 electric vehicles in 2030).	
<b>SME</b>					
<b>Name of the action:</b> Promotion of Renewable Energy					
<b>Nature:</b> Promotion, technology, financial mechanism, incentives					
<b>Coordination/Support:</b> GAF, Central Bank of Armenia					
<b>Financing:</b> KfW Loan: EUR 5.6 mln					
<b>Implementing Partners:</b> Local commercial banks					
Investments in renewable energy sources of energy generation (small hydropower plants, solar photovoltaic stations, solar thermal heaters)	The goal is to support the increase of RE share in power generation mix. Progress indicators: electricity generation from RE sources.	<b>Ongoing</b> Project started in 2007	During 2017-2019 the project supported: <ul style="list-style-type: none"> <li>• construction of 9 PVs (with capacity of up to 1 MW) with total installed capacity of 8.5 MW (Annual electricity generation: 13.6 GWh);</li> <li>• construction/reconstruction of 53 SHPPs with total installed capacity of 136.7 MW (among them 37 new HPPs with total capacity of 98 MW, reconstruction of SHPPs didn't affect the generation);</li> <li>• 514 small scale PVs (up to 500 kW) and 2,692 SWHs.</li> </ul>	To avoid double counting, emissions reduction assessment from RE sources (including solar PVs with capacity of up to 1MW) has been done on generation side. Emissions reduction from PVs have been included in assessment of "Autonomous power generators (up to 500 kW)". In this measure only SWHs were considered.	Annual emission reduction from RE (Small HPPs, PVs and SWHs) in 2019: 131.5 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Energy Efficiency Program for SMEs (GAF-EE)					
<b>Nature:</b> Promotion, technology, financial mechanism, incentives					
<b>Coordination/Support:</b> GAF, Central Bank of Armenia					
<b>Financing:</b> KfW Loan EUR 22.24 mln					
<b>Implementing Partners:</b> Central Bank of Armenia					
Investments in modern energy efficient equipment and machinery, building infrastructure and projects for energy saving.	The aim is to fund the energy efficiency projects to achieve average energy savings of 28% from the baseline. Progress indicators: Disbursed funds, energy savings.	<b>Ongoing</b> Project started in 2016	During 2017-2019 in total 452 energy efficient projects have been disbursed with total amount of AMD 11.9 bln (data have been provided by the GAF).	Emission reductions have been assessed based on total energy savings of 364.29 GWh during 2017-2019 (on average 28% improvement from the baseline) provided by the GAF.	Annual emission reduction in 2019: 139.3 Gg CO <sub>2</sub> eq.

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Investments in green technology (RE and EE) for Small and medium-sized enterprises (SMEs) and corporates					
<b>Nature:</b> Promotion, technology, financial mechanism					
<b>Coordination/Support:</b> EBRD, EBRD Green Economy Financing Facility (GEFF)					
<b>Financing:</b> The loan in the amount of USD 20 mln is co-financed by the EBRD, Green Climate Fund (GCF) and Climate Investment Funds (CIF).					
<b>Implementing Partners:</b> Local banks					
Energy efficiency and RE loans for on-lending to SMEs and business through 6 partner financial institutions (Ameriabank, ArmSwissBank, Inecobank, ACBA Leasing, ACBA-CREDIT ACRICOLE BANK, HSBC).	Contribution towards building a green economy in Armenia by supporting the investments in green technology, especially in climate adaptation and mitigation technologies. Progress indicators: Disbursed amounts, energy savings.	<b>Ongoing</b> Project started in 2019	Reducing primary energy usage by 47,969 MWh/year from implementation of EE projects. Implementation of 107 solar PV projects with 15.5 MW installed capacity (data have been provided by GEFF).	Emission reduction assessment was done based on final energy savings (28,130 MWh) provided by GEFF. Emissions reduction from PVs have been included in assessment of "Autonomous power generators (up to 500 kW)".	Annual emission reduction from EE measures in 2019: 2.0 Gg CO <sub>2</sub> eq. and from RE generation in 2019: 17.8 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Support the development of EE lending product within the commercial banks, enabling households and business customers to take loans for EE improvements					
<b>Nature:</b> Promotion, technology, financial mechanism					
<b>Coordination/Support:</b> GGF, Local banks: Araratbank, Inecobank, ACBA leasing and ACBA CREDIT ACRICOLE BANK					
<b>Financing:</b> USD 24.354 mln loan facilities have been provided from the Green for Growth Fund to local banks (Araratbank, Inecobank, ACBA leasing and ACBA). In 2019 GGF added USD 2 mln loan facilities through ACBA Leasing to further strengthen EE lease financing portfolio					
<b>Current Partner Institutions:</b> ACBA Leasing and ACBA CREDIT ACRICOLE BANK					
Support the development of EE lending product within the commercial banks, enabling households and business customers to take loans for EE improvements (buildings, equipment, vehicles) and use of RE (SWHs replacing natural gas).	The aim is to fund the energy efficiency projects and renewable energy projects that achieve at least 15% reduction in energy use or emissions. Progress indicators: Energy savings, emission reductions.	<b>Ongoing</b> Project started in 2012	In 2019 Primary energy savings made 42,278 MWh/year (Data provided by the GGF).	Emissions reduction assessment was done based on the annual final energy savings.	Annual emission reduction in 2019: 16.9 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> "Enhancing SME competitiveness through promotion and wider use of sustainable innovative technologies"					
<b>Nature:</b> Technology improvement, capacity building, incentives					
<b>Coordination/Support/Implementing Partners:</b> PIN Scrl - Educational and scientific services for the University of Florence, Italy (Lead partner), Tourism Regional Center, Municipalities and Communities					
<b>Financing:</b> Total: EUR 2.085 mln (EU Contribution: EUR 1.5 mln)					

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
Promotion of environmentally friendly tourism (eco-tourism) and adoption of renewable energy sources and efficient energy practices in the sector	Construction of a 1 MW solar PV and installation of at least 25 solar thermal panels. Progress indicators: energy generation from installed PVs.	<b>Completed</b> 2016-2019	RE production from PV is 1.6 GWh/year and from SWHs - 0.11 GWh/year.	Emissions reduction assessment was done based on the projected energy savings (both electricity and natural gas) from SWHs. To avoid double counting emissions reduction from 1MW PV have been assessed on generation side.	Annual emission reduction from SWH in 2019: 0.03 Gg CO <sub>2</sub> eq., and from RE in 2019: 1.11 Gg CO <sub>2</sub> eq.
<b>Demand Side Renewables</b>					
<b>Name of the action:</b> Autonomous power generators (up to 500 kW)					
<b>Nature:</b> Legislative, regulatory, technology, incentives					
<b>Coordination/Support/Implementing Partners:</b> GoA, Private investments, KfW, GAF, GEFF, GGF, UNDP, GEF, EU, R2E2, Local banks					
Creating regulatory framework and incentives for promotion of solar generation for own needs through amendments to the RA Law on Energy and to the RA Law on Energy Saving and Renewable Energy, 2016.  Customers are enabled to generate electricity from solar energy for own needs with a peak capacity of up to 500 kW without licensing, as well as to sell the excess generation to the grid (net metering).	It is envisaged by the Strategy (up to 2040) that total installed capacities of autonomous producers will reach 100 MW by 2023.  Progress indicators: Total installed capacity of autonomous producers	<b>Ongoing</b> Started in 2017	As of 01.11.2020: 3,785 autonomous energy producers are connected to the grid with total capacity of 69.8 MW and additional 271 with total capacity of 7 MW are under construction (ENA data). This figure includes both solar PVs installed in the frames of RE financing programs and PVs installed by the residents at their own expenses.	To avoid double counting as well as missing any autonomous energy producers, the impact assessment has been done considering the total capacity of autonomous energy producers connected to the grid. The capacities of those producers which are under construction and those which will be constructed by 2023 were considered as well.	Expected annual emission reduction in 2023: 117.8 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Reducing “energy poverty” in Armenia’s non-gasified rural communities through supporting installation of solar water heaters and PV panels including “Model of accelerated implementation of the SDG 7 on Affordable and Clean Energy” component of the “Innovative Solutions for SDG Implementation in Armenia” Project					
<b>Nature:</b> Capacity building, awareness raising, incentives					
<b>Coordination/Support:</b> UNDP, R2E2					
<b>Financing:</b> “Innovative Solutions for SDG Implementation in Armenia” Project, Revolving Fund (R2E2)					
<b>Implementing Partners:</b> ACBA-CREDIT ACRICOLE BANK, ACBA Leasing, Global credit					
Popularization of solar solutions for private households in targeted regions and introduction of affordable financial instruments to empower	Expected RE generation: 31GWh from 5,400 SWHs and 200 PV plants.	<b>Ongoing</b> 2017–2022	RE generation as 01.07.2020: 13.6 GWh from commissioning of 3,042	Emissions reduction assessment was done based on RE amount produced by SWHs. Emissions reduction from PVs have been	Expected annual emission reduction from SWHs in 2022: 8.6

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
vulnerable population to combat “energy poverty”.	Progress indicators: energy generation from installed PVs and number of SWHs		SWHs and 131 PVs. (Figures provided by the R2E2).	included in assessment of “Autonomous power generators (up to 500 kW)”.	Gg CO <sub>2</sub> eq., and from PVs: 9.3 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> EU for Yerevan Solar Community					
<b>Nature:</b> Technology improvement, capacity building, incentives					
<b>Coordination/Support:</b> EU Delegation to Armenia, Municipality of Yerevan					
<b>Financing:</b> Total Project Budget: EUR 1.25 mln; EU Contribution: EUR 1 mln					
<b>Implementing Partners:</b> Municipality of Yerevan					
Support to the multi-apartment building management bodies (condominiums) in managing the energy use through roof top PV systems to cover the energy consumption used for common areas. The revenue generated by the project will allow the condominiums to finance the building's energy efficiency measures.	Establish a model for ensuring 100% use of RE in about 104 multi apartment buildings to cover electricity demand for elevators and illumination of common spaces. Progress indicators: electricity demand covered by RE sources.	<b>Ongoing</b> 2018-2021	The works on installation of solar-powered systems, indoor and outdoor LED lights are on-going.	Emissions reductions assessment was done based on RE annual generation provided in “Yerevan Solar Community” Project document (2,130 MWh/ year). Emissions reduction from PVs have been included in assessment of “Autonomous power generators (up to 500 kW)”.	Expected annual emission reduction in 2020: 2.5 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Community Energy Efficiency /EE/ Project					
<b>Nature:</b> Capacity building, technology, incentives					
<b>Coordination/Support:</b> R2E2					
<b>Financing:</b> R2E2's Revolving Fund					
<b>Implementing Partners:</b> ACBA-CREDIT ACRICOLE BANK, Converse Bank					
Installation of solar photovoltaic systems, installation of solar water heaters, replacement of inefficient street lighting system with LED lamps.	Expected annual RE generation in 10 communities: 3 GWh from installation of 50 solar heaters and 40 PV plants (160 kWp). Progress indicators: installed capacity of solar PVs and SWHs.	<b>Ongoing</b> Started in 2017	As of 2019: 1.43 GWh RE generation from commissioning of 30 SWHs and 20 PVs (80 kWp).	Emissions reduction assessment was done based on RE generation. Emissions reduction from PVs have been included in assessment of “Autonomous power generators (up to 500 kW)”.	Expected annual emission reduction from SWHs in 2019: 0.9 Gg CO <sub>2</sub> eq., and from RE in 2019: 0.18 Gg CO <sub>2</sub> eq.

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> “EU 4 Armenia’s Sustainable Energy” Project: Renewable Energy Promotion Program in Aparan and Artik Communities					
<b>Nature:</b> Technology improvement, capacity building, incentives					
<b>Coordination/Support:</b> EU Delegation to Armenia, GoA, Municipalities					
<b>Financing:</b> Total Project Budget: EUR 0.9 mln (EU contribution: EUR 0.72 mln (80%), State Subvention Program, Artik and Aparan municipalities)					
<b>Implementing Partners:</b> “Foundation to Save Energy” (ESF) and “Union of Communities of Armenia” (UCA), Artik and Aparan municipalities					
Renewable energy promotion in Aparan and Artik towns.	Solar PVs with capacities of 25 kW in Aparan and 600 kW in Artik. Progress indicators: installed capacity of solar PVs	<b>Ongoing</b> Approved in 2018	Subvention is approved, construction works started. Solar PV plant in Aparan was commissioned in 2020.	Emissions reductions assessment was done based on RE annual generation of 1.0 GWh. Emissions reduction from PVs have been included in assessment of “Autonomous power generators (up to 500 kW)”.	Expected annual emission reduction in 2019: 0.72 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> GEF Small Grants Programme, UNDP-GEF					
<b>Nature:</b> Combination of capacity building, technology, promotion, incentives					
<b>Coordination/Support:</b> UNDP					
<b>Financing:</b> GEF grants					
<b>Implementing Partners:</b> UNDP-GEF Project, communities					
Introduction of innovative low-carbon technologies and solutions in rural communities	Expected annual RE generation of 1.2 GWh within 2017-2019. Progress indicators: capacity of installed solar PVs and SWHs in rural communities.	<b>Ongoing</b>	RE generation: 1.2 GWh electric and thermal energy resulted from SWHs and PVs with the total capacity of 500 kW in over 60 buildings and constructions within 2017-2019.	Emissions reduction assessment was done considering RE annual generation provided by the Project. Emissions reduction from PVs have been included in assessment of “Autonomous power generators (up to 500 kW)”.	Annual emission reduction for SWHs in 2019: 0.2 Gg CO <sub>2</sub> eq., and from RE in 2019: 0.55 Gg CO <sub>2</sub> eq.
<b>Regulatory</b>					
<b>Name of the action:</b> “Regulatory Framework to Promote Energy Efficiency in Countries of the Eurasian Economic Union” UNDP-RTF regional project					
<b>Nature:</b> Regulatory, capacity building, awareness raising					
<b>Coordination/Support:</b> UNDP, RTF, Government of Armenia					
<b>Financing:</b> USD 8.51 mln (for 5 countries)					
<b>Implementing Partners:</b> UNDP, Government of Armenia					
The project aims to reduce energy consumption and associated GHG emissions by increasing the energy efficiency of lighting, household appliances and buildings' engineering equipment.	The goal of the project was to improve the regulatory framework for energy efficiency. Progress indicators: Energy savings.	<b>Completed</b> 2017–2019	Electricity savings through 2030 3,167 GWh (Cumulative for 11 years) (Figures provided in Final Report).	Emission reduction were assessed based on annual electricity savings provided in Final Report.	Emission reduction in 2030: 284.2 Gg CO <sub>2</sub> eq.



Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>Irrigation</b>					
<b>Name of the action:</b> Irrigation System Enhancement Project					
<b>Nature:</b> Technology improvement, capacity building					
<b>Coordination/Support:</b> WB, Ministry of Economy and Water Committee of RA					
<b>Financing:</b> Total USD 39.24 mln: WB/IBRD loan: USD 31.74 mln, Government USD 7.5 mln (in 2017 additional USD 2 mln were provided by WB).					
<b>Implementing Partners:</b> Ministry of Economy and Water Committee					
Reduce energy consumption and improve irrigation conveyance efficiency in targeted irrigation schemes	Energy saving 36.8 GWh/year. Progress indicators: energy savings	<b>Completed</b> 2013- 2019 (was extended for 2 years)	Improved irrigation and drainage services on more than 12,000 hectares resulted in reduced amount of energy used and reduction of water losses.	Emissions reduction assessment was done considering electricity savings resulted from improved efficiency of irrigation schemes, provided in 2017 Project Paper (WB).	Achieved emission reduction in 2019: 27.5 Gg CO <sub>2</sub> eq.
<b>Industry</b>					
<b>Name of the action:</b> Production of new type cement					
<b>Nature:</b> Technology improvement					
<b>Coordination/Support:</b> "Hrazdan Cement Corporation" LLC					
<b>Financing:</b> Private investment					
<b>Implementing Partners:</b> "Hrazdan Cement Corporation" LLC					
Production of new type cement through technology upgrading in cement factory.	Reduced electricity consumption as a result of switch to production of high-quality cement with lower clinker fraction. Lower quantity of clinker requires less electricity. Progress indicators: electricity consumption.	<b>Ongoing</b> 2020-2022	The activity has just started.	Emissions reduction assessment was done considering electricity savings as a result of technology improvement provided by the experts: 2.02 GWh in 2022.	Expected emission reduction in 2022: 1.6 Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Technology upgrading in cement factory					
<b>Nature:</b> Technology improvement					
<b>Coordination/Support:</b> "Hrazdan Cement Corporation" LLC					
<b>Financing:</b> Private investment					
<b>Implementing Partners:</b> "Hrazdan Cement Corporation" LLC					
Modernizations of compressors cooling system and heat exchangers of clinker kiln	Energy savings (reduction of natural gas and electricity consumption).	<b>Planned</b> 2021-2022	The activity has not yet started.	Emissions reduction assessment was done considering both natural gas and electricity savings resulted from technology improvement provided by the experts. In 2022: Natural gas savings: 2,624,000 m <sup>3</sup> . Electricity savings: 3.27 GWh.	Expected annual emission reduction in 2022: 9.6 Gg CO <sub>2</sub> eq., from natural gas and electricity savings.

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>IPPU</b>					
<b>Name of the action:</b> Production of new high-quality cement (Technology upgrading in cement factory)					
<b>Nature:</b> Technology improvement					
<b>Coordination/Support:</b> "Hrazdan Cement Corporation" LLC					
<b>Financing:</b> Private investment					
<b>Implementing Partners:</b> "Hrazdan Cement Corporation" LLC					
Production of new high-quality cement with lower clinker fraction.	Production of high-quality cement with lower clinker fraction. Progress indicators: composition of cement	<b>Ongoing</b> 2020-2022	The activity has just started.	Emissions reduction assessment was done considering decreased quantities of clinker in new high-quality cement provided by the experts.	Annual emission reduction in 2022: 15.3 Gg CO <sub>2</sub> eq.
<b>AFOLU</b>					
<b>Agriculture</b>					
<b>Mitigation measure:</b> Cattle Breeding Development Program in RA, 2019-2023					
<b>Nature:</b> Technological improvement: Improving the gene pool of cattle bred in Armenia.					
<b>Coordination/Support:</b> Affordable lending by the Government of the Republic of Armenia (provision of state-subsidized soft loans) using public-private partnership tools.					
<b>Coverage:</b> Reduction of methane emissions from the cattle's enteric fermentation.					
Import, breeding of animals with high digestibility of fodder, crossing with local cows to improve the local Caucasian gray breed and reduce the number of the local breed	It is planned to increase the number of new breeds to 180,000 by 2030. Progress indicators: Number of new imported cows with high digestibility of fodder.	<b>Ongoing</b> Started in 2007 and the financial support currently provided by the GoA will continue until 2025.	The loans provide the opportunity to import about 3,000 breeding animals annually. As of 2020, about 24 thousand breeding animals have been imported.	GHG emission reductions have been assessed based on the methodology provided in 2006 IPCC Guidelines considering the difference between methane emission from enteric fermentation of local and imported breeding animals as well as crossbred animals	Expected reduction of GHG emissions in 2025: 49.3 Gg CO <sub>2</sub> eq. in 2030: 51.3 GgCO <sub>2</sub> eq.
<b>Coverage:</b> Reduction of methane emissions from cattle manures management.					
				GHG emission reductions have been assessed based on the methodology provided in 2006 IPCC Guidelines considering the difference of the methane emissions from the manure management of local and imported breeding animals, as well as crossbred animals.	Expected reduction of GHG emissions in 2025: 2.4 Gg CO <sub>2</sub> eq. in 2030: 3.0 Gg CO <sub>2</sub> eq.

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implemen- tation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>Coverage:</b> Reduction of Nitrous oxide emissions from cattle manures management.					
				GHG emission reductions have been assessed based on the methodology provided in 2006 IPCC Guidelines considering the difference of the Nitrous oxide emissions from the manure management of local and imported breeding animals, as well as crossbred animals.	Expected reduction of GHG emissions in 2025: 0.9 Gg CO <sub>2</sub> eq. in 2030: 1.2 Gg CO <sub>2</sub> eq.
<b>Mitigation measure:</b> Applying of a new system of pasture management and alternate grazing of animals.					
<b>Nature:</b> Technological improvement: application of rotational grazing technology.					
<b>Coverage:</b> Reducing Indirect Nitrous Oxide Emissions by reducing uncollected manure in pastures.					
<b>Coordination/Support:</b> Implementation of pasture improvement measures implemented by the Government of the Republic of Armenia and provision of affordable loans.					
Creation of appropriate infrastructure in remote pastures: improvement of roads, irrigation of pastures, and the possibility of alternating grazing by dividing pastures into separate pasture. As a result, manure from pasture is collected immediately after grazing, which reduces the amount of uncollected manure on pastures.	It is expected that about 50,000 hectares of unused pasture will be covered annually, and the annual amount of manure collected will be around 160,000 tons. Progress indicator: area of managed pastures, collected manure.	<b>Ongoing</b>	In 2017-2020, surface improvement of pastures and implementation of a new system of rotational grazing on 5,000 hectares was carried out.	GHG emission reductions have been assessed based on the methodology provided in 2006 IPCC Guidelines, taking into account changes in the amount of uncollected manure (left in the pastures) and dry stored and composted manure.	Expected emission reduction in 2025: 0.2 Gg CO <sub>2</sub> eq. in 2030: 0.8 Gg CO <sub>2</sub> eq.
<b>Forestry</b>					
<b>Mitigation measure:</b> Afforestation and reforestation works (planting).					
<b>Nature:</b> Capacity building, technological improvement.					
<b>Coverage:</b> The increase of CO <sub>2</sub> removals due to afforestation and reforestation					
<b>Coordination/Support:</b> ATP USA Office, "Implementing Sustainable Land and Forest Management in the Mountainous Landscapes of Northeastern Armenia" UNDP-GEF Project, Integrated Biodiversity Management, South Caucasus (IBiS) Project, "Hayantar" SNTP					
Afforestation and reforestation measures.	Implementation of afforestation and reforestation measures. Progress indicators: area of afforestation and reforestation.	<b>Completed</b> 2016-2020	About 565.8 hectares of forest have been planted and restored.	CO <sub>2</sub> removals were assessed based on the methodology provided in 2006 IPCC Guidelines considering the areas of afforestation and reforestation.	Annual removals: 3.9 Gg CO <sub>2</sub> eq.

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implementation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>Mitigation measure:</b> Installation of solar photovoltaic panels and water heaters, provision of energy saving stoves.					
<b>Nature:</b> Capacity building, technological improvement.					
<b>Coverage:</b> Increase CO <sub>2</sub> removals and reduce carbon loss from wood by reducing fuelwood consumption.					
<b>Coordination/Support/Financing:</b> "Implementing Sustainable Land and Forest Management in the Mountainous Landscapes of Northeastern Armenia" UNDP-GEF Project, GEF Grant: 100,040.7 USD					
Improvement and replacement of firewood heating systems in secondary and pre-school educational institutions by providing energy-saving stoves and solar photovoltaic panels and solar water heaters.	Saving firewood, reducing logging, preserving forest areas and increasing biomass. Progress indicator: reduced forest logging for fuelwood, avoided wood burning.	<b>Completed</b> 2017-2020	344 cubic meters of wood are saved annually. 2.7 hectares of forest are not cut down annually.	CO <sub>2</sub> removals have been assessed based on the methodology provided in 2006 IPCC Guidelines.	Annual reduction of GHG emissions 113.1 t CO <sub>2</sub> eq. in 2020.
<b>Land Use</b>					
<b>Mitigation measure:</b> Introduction of management system and restoration of degraded pastures, grasslands and arable lands					
<b>Nature:</b> Capacity building, technological improvement.					
<b>Coverage:</b> Increase in CO <sub>2</sub> removals due to biomass growth and storage and accumulation of carbon reserves.					
<b>Coordination/Support:</b> "Implementing Sustainable Land and Forest Management in the Mountainous Landscapes of Northeastern Armenia" UNDP-GEF Project					
Create the necessary conditions for the effective management of degraded pastures, grasslands and arable lands. Intensive land restoration, sowing and cultivation works were carried out.	Restoration of degraded pastures, grasslands and arable lands. Progress indicator: area of restored pastures, grasslands and arable lands.	<b>Completed</b> 2017-2020	1000 hectares of unused and degraded pastures, grasslands and arable land have been restored and cultivated.	CO <sub>2</sub> removals have been assessed based on the methodology provided in 2006 IPCC Guidelines considering the converted areas.	Expected annual reduction of GHG emissions 26 Gg CO <sub>2</sub> eq. in 2020.
<b>WASTE</b>					
<b>Coverage:</b> Reduction of CH <sub>4</sub> emissions by improving the Solid Waste (SW) management system					
<b>Name of the action:</b> Nubarashen Landfill Gas Capture and Power Generation CDM Project					
<b>Nature:</b> Infrastructure development					
<b>Methodology:</b> CH <sub>4</sub> emissions from solid waste disposal sites have been calculated using the IPCC methodology for this category					
<b>Coordination/Support:</b> Yerevan Municipality, Shimizu Corporation (Japan)					
CH <sub>4</sub> emission reduction through the capture and combustion of landfill gas.	135 Gg CO <sub>2</sub> eq. emission reduction annually. Progress indicators: captured landfill gas.	<b>Ongoing</b> Launched in 2007	The gas capture and combustion system were constructed in the Nubarashen landfill.	Emission reductions for the period 2014-2016 were reported in BUR2, more recent information is not available.	Not Available

Description/ objectives	Quantitative goals and progress indicators	Time frame	Progress of implemen- tation/steps taken or envisaged/ achieved results	Assumptions	Estimated outcomes / GHG emissions reduction Gg CO <sub>2</sub> eq.
<b>Name of the action:</b> Kotayk and Gegharkunik Solid Waste Management Project					
<b>Nature:</b> Infrastructure and waste management development					
<b>Coordination/Support:</b> EBRD, Ministry of Territorial Administration and Infrastructure, Municipalities					
<b>Financing:</b> EUR 5.5 mln loan from EBRD, EUR 3.5 mln grant from EU Neighborhoods Investment Facility, EUR 2 mln grant from E5P					
<b>Implementing partners:</b> Ministry of Territorial Administration and Infrastructure, communities					
Improvement of the solid waste collection and management services in Kotayk and Gegharkunik regions of Armenia, including the construction of a new landfill in Hrazdan. The goal is to build landfills for rural and urban communities in Kotayk and Gegharkunik marzes.	4.6 Gg of CO <sub>2</sub> eq. annual emissions reduction in 2024. Environmental and social benefits for residents. Progress indicators: captured landfill gas.	<b>Ongoing</b> 2016-2023	EBRD has secured funds for the project implementation. The preparation of the design of the first EU compliant regional landfill and relevant infrastructure in Hrazdan town. The construction of the new landfill is planned to start in 2021 and to finish in 2023.	The estimate of emissions reduction was provided by the EBRD and done based on the projected recovery of landfill gas from existing dumpsite(s) and from the new landfill.	The annual emission reduction expected: 4.6 Gg of CO <sub>2</sub> eq. in 2024
<b>Name of the action:</b> Solid Waste Management in Yerevan					
<b>Nature:</b> Infrastructure and waste management development					
<b>Coordination/Support/ Implementing partners</b> EBRD, EIB, E5P, NIF					
<b>Financing:</b> overall cost` 28.4 mln EUR (EUR 16.5 mln loan from EBRD and European Investment Bank (EIB), EUR 8 mln grant from EU Neighborhoods Investment Facility, EUR 1.9 mln grant from EBRD TA Fund, EUR 2 mln grant from E5P)					
<b>Implementing partners:</b> Ministry of Territorial Administration and Infrastructure					
In the area of about 29 hectares adjacent to the existing landfill in Nubarashen, it is planned to design, build, operate 2 cells in accordance with European standards, as well as to isolate the landfills of Nubarashen and Ajapnyak.	140 Gg of CO <sub>2</sub> eq. annual emission reduction in 2025. Reduce adverse environmental and health impacts. Progress indicators: captured landfill gas.	<b>Ongoing</b> 2016-2024	The construction of the new landfill is planned to start in 2021 and to finish in 2024.	The estimate of emissions reduction done based on the projected recovery of landfill gas from existing dumpsite(s) and from the new landfill.	Expected annual emission reduction: 140 Gg CO <sub>2</sub> eq. in 2025
<b>Name of the action:</b> Integrated Solid Waste Management System in Vanadzor					
<b>Nature:</b> Infrastructure and waste management development					
<b>Coordination/Support:</b> Ministry of Territorial Administration and Infrastructure, Vanadzor Municipality, KfW loan					
Development of waste management to achieve a significant step-change in waste management practices, including waste collection and disposal infrastructure.	10.15 Gg of CO <sub>2</sub> eq. annual emissions reduction in 2025. Progress indicators: captured landfill gas.	<b>Planned</b>	GoA and KfW are negotiating financing for the project implementation. In 2017, the Project EIA was implemented.	The estimate of emissions reduction is provided in the Feasibility Study implemented by KfW and was done considering landfill gas capture and flaring of 50% of developed methane compared to baseline.	Expected annual emission reduction: 10.15 Gg CO <sub>2</sub> eq. in 2025



**Table 3.2 Additional mitigation actions and their effects in Energy Sector**

Descriptions/ objectives	Methodologies/ Assumptions	GHG emissions reduction Gg CO <sub>2eq.</sub>
<b>Energy (generation side)</b>		
<b>Name of the action:</b> Construction of medium size Hydro Power Plant		
Increase the share of renewables in power generation mix through construction of medium-size HPP	The assessment of the impact has been performed assuming that new medium size HPP with the capacity of 66 MW will be commissioned in 2027.	Expected annual emissions reduction in 2027: 113.5 Gg CO <sub>2 eq.</sub>
<b>Name of the action:</b> Construction of new wind farms		
Increase the share of renewables in power generation mix through construction of Wind Farms	The assessment of the impact has been performed assuming that the Wind Farms with the total capacity of 250 MW will be commissioned in 2030	Expected annual emissions reduction in 2030: 365.2 Gg CO <sub>2 eq.</sub>
<b>Energy (demand side)</b>		
<b>Name of the action:</b> Autonomous power generators (up to 500 kW)		
More ambitious development of solar PVs on demand side. It is envisaged that total installed capacities of autonomous producers will reach 200 MW by 2030.	The assessment of the impact has been performed assuming that will reach 200 MW by 2030.	Expected annual emissions reduction in 2030: 198.4 Gg CO <sub>2 eq.</sub>
<b>Name of the action:</b> Promoting fuel switching to electricity in transport		
To promote the acquisition and use of electric vehicles in the country by creating favorable conditions.	The assessment of the impact has been performed assuming that share of electric vehicles in the county will reach 25% by 2030.	Expected annual emissions reduction in 2030 is 252.1 Gg CO <sub>2 eq.</sub>

## 3.2 Assessment of mitigation potential in Energy Sector

As it is stated above, the greenhouse gas emissions reduction potential has been assessed for the Energy sector up to 2030 for different development scenarios.

### a) Energy Policy of RA

The assessment has been performed based on the main provisions of the Strategy and Action Plan, which identifies specific actions to be implemented for achieving goals set forth in the Strategy.

The Strategy defines the main priorities for the development of the Energy sector, which are the maximum utilization of renewable energy and energy saving potential, life extension of the Armenian Nuclear Power Plant, construction of North-South transit corridor with 400 kV power transmission line and gradual liberalization of the electricity market. While considering the available local resources and development trends of solar technology around the world, the construction of solar power plants will be a priority to minimize reliance on imported energy resources and to strengthen Armenia's energy security and competitiveness.

The RA Government has intended to increase the share of solar energy generation in total to at least 15% or 1.8 billion kWh by 2030. To this end, solar power plants with the capacity of about 1000 MW, including autonomous ones, are planned to be constructed<sup>35</sup>.

- Development of utility scale solar PVs has already become a reality with the start of construction of the 55 MW Masrik-1 solar PV plant (commissioning is expected in 2022). Construction of another seven solar PVs with total installed capacity of 520 MW is envisaged, while capacity of two plants will comprise 200 MW each.
- It is envisaged that the total installed capacity of small solar PVs (with capacity of "up to 5 MW",) will reach 200 MW in 2022 and 315 MW – by December 2029.

- The construction of solar PVs with a capacity of up to 1 MW was limited to a total capacity of 10 MW; 12 solar stations with a total capacity of 10 MW were connected to the grid.
- As of November 1, 2020, 3785 autonomous solar power plants (with capacity of "up to 500 kW") with the total installed capacity of 69.8 MW are connected to the grid. It is expected that the total installed capacity of such plants will reach to 100 MW in the next three years.

The Government of Armenia plans to gradually expand the implementation of the programs that will contribute to more buildings having their own individual heating and hot water production systems based on renewable energy resources<sup>36</sup>.

All sectors of the economy of Armenia, including transport, industry, multi-apartment buildings, commercial sector, energy transformation, etc. have a great potential for energy saving. The RA government will consistently create conditions for energy savings and, to this end, is planning to continue to carry out institutional reforms to promote energy savings in all sectors of the economy and promoting investments in development of renewable energy sources to minimize reliance on imported energy resources, to strengthen Armenia's energy security and competitiveness and ensure meeting Armenia's environmental goals and commitments<sup>37</sup>.

Following the Program of the Government of RA for 2019-2023 and the Strategy, National Program on Energy Saving and Renewable Energy of Republic of Armenia for 2021-2030 is currently being developed to set targets for the energy saving and renewable energy development in Armenia and to determine the means for their realization.

It should be noted that the developments foreseen by the Strategy were made possible by ensuring an appropriate legal

<sup>35</sup> Energy Sector Development Strategic Program

<sup>36</sup> Energy Sector Development Strategic Program

<sup>37</sup> Energy Sector Development Strategic Program

and institutional environment that supports development of renewable technologies and promotes implementation of energy saving measures. The most important ones are listed below:

*Amendments to the RA Energy Law (2014, 2016, 2017).*

- Aims at creating favorable conditions for renewable energy (RE) sources by extending the power purchasing agreement from RE sources (except for the small HPPs) from 15 to 20 years (2014).
- Promoting the solar energy generation for own needs with peak capacity of up to 500 kW (inclusive) by stipulating that such power plants generation can be carried out without the activity licenses issued by the PSRC (2016, 2017).

*Amendments to the RA Law on Energy Saving and Renewable Energy (2016, 2017, 2020)*

- Stipulates for mandatory compliance with the technical requirements in the new residential apartment buildings under construction, as well as in the objects constructed (rebuilt, repaired) at the expense of state funds (2016).
- Net metering for production of electricity by autonomous producers using solar energy has been adopted stipulating that final billing between an owner of a solar PV station (autonomous producer) and the grid is calculated based on the whole-year difference of generated and consumed amounts of electricity (2017).
- Products purchased to meet the needs of the state must meet the established requirements for energy efficiency (2020).  
The procurement of goods and equipment will be carried out on the basis of the requirements of the Law "On Procurement".

*The RA Law on Making Addendum to the RA Tax Code (2019)*

- According to the Law, starting from July 1, 2019, import and sale of vehicles powered by electric motors has been fully exempted from VAT until January 1, 2022.

*Technical rules and regulations* have been adopted with energy saving and energy

efficiency requirements in residential multi-apartment buildings under construction, as well as facilities under construction (reconstruction, renovation) by state funds (2018).

*Tariff Policy*

Tariff policy aims at ensuring targeted policy implementation for promoting development of renewable energy, and, more specifically electricity generation by solar PVs. Such tariff policy along with abovementioned legislative changes has already resulted in rapid development of solar PVs. Tariffs for solar PVs are distinguished as follows:

- Utility-scale solar PVs - the tariff is based on the proposed lowest tariff resulted from international competition.
- Up to 5 MW solar PVs - the tariff equals to the tariffs for SHPPs built on natural water flows, provided that the first tariff setting should be adopted by December 31, 2021 (inclusively).
- Solar PVs with an installed capacity of up to 1 MW (inclusively) and whose license for production of electricity was granted before November 1, 2018, inclusively – feed-in tariff.
- Solar PV power plants with up to 500 kW capacity – autonomous power generators with net-metering. Net balance is calculated on annual level and surplus electricity is sold to the grid at the rate of 50% of the tariffs set by the PSRC for the respective consumers' group.

**b) Approach to develop projections**

During the preparation of Armenia's Biennial Update Reports (through BUR1-BUR3) the model LEAP-Armenia was developed to generate projections of GHG emissions up to 2030 under several scenarios based on most recent strategic papers for Energy sector's development. The starting year for all scenarios in LEAP-Armenia is 2012.

The impact of mitigation actions in the current assessment is evaluated for the following scenarios:

- A "Without Measures" (WOM) projection excludes all policies and measures implemented, adopted, or planned after 2012. The demand growth

for electricity after 2012 is met by the existing and new thermal power plants. The nuclear power plant continues operation after 2027.

- A “*With Measures*” (WM) scenario includes those mitigation actions, which have already been implemented since 2012, are ongoing or planned for the nearest future and which are priority projects in the Strategy and Action Plan. For WM scenario two options were considered: WM1 scenario assumes commissioning of 1000 MW solar PVs and WM2 scenario - 700 MW of solar PVs by 2030.
- A “*With Additional Measures*” (WAM) scenario includes mitigation actions which provide more ambitious development of renewable energy sources and enhanced implementation of energy efficiency measures.

The starting year of WM and WAM projections in the current assessment is 2017.

To assess actual emissions reduction achieved by 2017, ex-post emissions estimate for WOM Scenario was compared with the real GHG inventory data (WM scenario). To evaluate the ex-post WOM scenario the previous assessment performed in the frame of BUR2 were corrected to account for: observed real GDP and population growth in 2015-2017, recalculations of base year GHG emission inventory (2012) that was performed in the

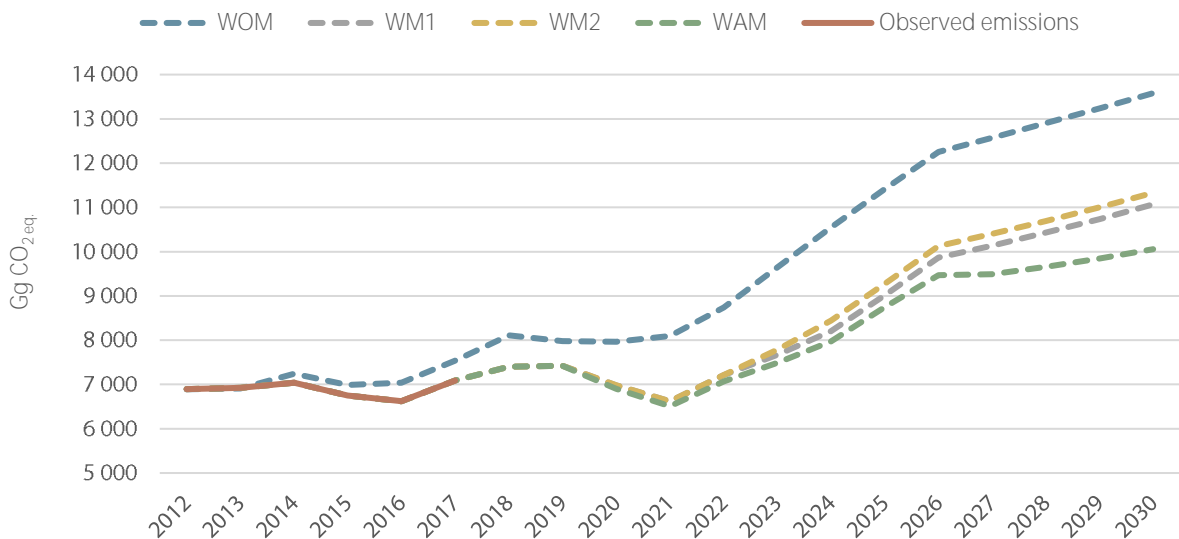
frames of the BUR3 and other parameters, such as electricity import-export values, climate variations, etc. As for WM scenario, the 2012-2017 years were calibrated to real inventory data from Armenia’s GHG emission inventory prepared in BUR3. The observed difference between ex-post WOM and WM scenarios shows the real measured emission reductions achieved in the period of 2012-2017.

To assess the emissions projections after 2017, the most recent information was used: on GDP and population growth rates, strategic papers for Energy sector’s development and on the implementation of mitigation actions. The real observed values were used for all exogenous factors for 2018-2019 (such as GDP and population growth rates, electricity exports, etc.), while the key assumptions after 2019 are like those used in the Strategy.

The LEAP-Armenia software was used to assess individual mitigation measures, which then were combined into alternative integrated WM and WAM scenarios. This approach allows assessing the marginal impact of an individual measure as well as the effect that occurs when multiple policies and measures are implemented together.

**c) The main results**

The GHG emissions under the developed scenarios are presented in Figure 3.1 including both ex-post evaluations for 2012-2017 and projections for 2018-2030.



**Figure 3.1 GHG emissions under the WOM, WM1, WM2 and WAM scenarios, Gg CO<sub>2</sub> eq.**

The difference between ex-post evaluation of WOM scenario and real observed emissions in 2017 shows actual emissions reduction achieved by 2017, which equals to 452 Gg CO<sub>2</sub> eq.

Under WM1 scenario the total GHG emissions decrease by 18.5% in 2030, compared to WOM scenario, under WM2 - by 16.6% and under WAM scenario - by 26.0%.

As it can be seen in Figure 3.1, the decrease of GHG emissions is observed during 2019-2021 in WM and WAM scenarios,

which is caused by the decrease of net electricity exports in 2019 compared with 2018 and addition of new solar and small hydro capacities.

In all scenarios there is a sharp increase of GHG emissions in 2021-2026 due to the increase of electricity exports pursuant to the contractual obligations under Iran-Armenia Electricity-for-Gas Swap Agreement resulted in increased generation by thermal power plants<sup>38</sup>.

Table 3.3 provides GHG emissions under WOM, WM1, WM2 and WAM scenarios.

**Table 3.3 GHG emissions under the WOM, WM1, WM2 and WAM scenarios, Gg CO<sub>2</sub> eq.**

Scenarios/Categories	2012	2017	2020	2025	2030
<b>WOM</b>					
Electricity Generation	1,618	1,653	1,807	3,818	4,800
Demand Sectors	3,768	4,198	4,482	5,108	5,829
Fugitive emissions from Natural Gas Transmission, Storage and Distribution	1,506	1,688	1,793	2,490	2,951
<b>Total</b>	<b>6,892</b>	<b>7,539</b>	<b>8,083</b>	<b>11,416</b>	<b>13,579</b>
<b>WM1</b>					
Electricity Generation	1,618	1,299	1,007	2,031	2,871
Demand Sectors	3,768	4161	4,359	4,926	5,690
Fugitive emissions from Natural Gas Transmission, Storage and Distribution	1,506	1,627	1,617	2,059	2,506
<b>Total</b>	<b>6,892</b>	<b>7,087</b>	<b>6,983</b>	<b>9,016</b>	<b>11,068</b>
<b>WM2</b>					
Electricity Generation	1,618	1,299	1,007	2,234	3,080
Demand Sectors	3,768	4,161	4,359	4,926	5,690
Fugitive emissions from Natural Gas Transmission, Storage and Distribution	1,506	1,627	1,617	2,111	2,560
<b>Total</b>	<b>6,892</b>	<b>7,087</b>	<b>6,983</b>	<b>9,271</b>	<b>11,330</b>
<b>WAM</b>					
Electricity Generation	1,618	1,299	962	1,923	2,265
Demand Sectors	3,768	4,161	4,338	4,813	5,483
Fugitive emissions from Natural Gas Transmission, Storage and Distribution	1,506	1,627	1,601	2,007	2,307
<b>Total</b>	<b>6,892</b>	<b>7,087</b>	<b>6,901</b>	<b>8,742</b>	<b>10,055</b>

It should be mentioned that there are significant changes in current GHG emissions projections (Table 3.3) compared with those reported in the BUR2 for all scenarios. The main reasons for these differences are the change in assumption on the life extension of current nuclear NPP, updated projections of energy demand drivers and electricity exports, and recalculations of time series of GHG inventory done in the frame of BUR3.

Table 3.4 presents the emission reductions under WM1, WM2 and WAM scenarios compared to the WOM scenario. It breaks down emissions reductions by sector in which mitigation actions take place, while the demand side measures include both direct emission reductions, as well as those associated with corresponding reductions in electricity losses and fugitive emissions.

<sup>38</sup> Energy Sector Development Strategic Program



**Table 3.4 Emissions reduction under WM1, WM2 and WAM scenarios compared to WOM, Gg CO<sub>2</sub> eq.**

Scenarios/Categories	2017	2020	2025	2030
<b>WM1</b>				
<b>Reductions from transformation side measures, including associated fugitive reductions</b>	<b>311</b>	<b>545</b>	<b>1,468</b>	<b>1,465</b>
Hydro	168	343	384	357
Utility scale solar	0	61	795	803
Wind	0	0	7	6
Losses in Electric Networks	142	140	282	298
<b>Reductions from demand side measures, including associated fugitive reductions</b>	<b>141</b>	<b>556</b>	<b>932</b>	<b>1,047</b>
Direct emission reductions from demand sectors	78	198	274	211
Indirect emission reductions from electricity savings	62	357	659	836
<b>Total</b>	<b>452</b>	<b>1,100</b>	<b>2,400</b>	<b>2,512</b>
<b>WM2</b>				
<b>Reductions from transformation side measures, including associated fugitive reductions</b>	<b>311</b>	<b>545</b>	<b>1,189</b>	<b>1,188</b>
Hydro	168	343	382	352
Solar	0	61	545	564
Wind	0	0	7	6
Losses in Electric Networks	142	140	255	266
<b>Reductions from demand side measures, including associated fugitive reductions</b>	<b>141</b>	<b>556</b>	<b>955</b>	<b>1,061</b>
Direct emission reductions from demand sectors	78	198	280	216
Indirect emission reductions from electricity savings	62	357	675	845
<b>Total</b>	<b>452</b>	<b>1,100</b>	<b>2,145</b>	<b>2,250</b>
<b>WAM</b>				
<b>Reductions from transformation side measures, including associated fugitive reductions</b>	<b>311</b>	<b>542</b>	<b>1,442</b>	<b>2,005</b>
Hydro	168	344	384	494
Solar	0	61	796	824
Wind	0	6	7	380
Losses in Electric Networks	142	132	255	308
<b>Reductions from demand side measures, including associated fugitive reductions</b>	<b>141</b>	<b>640</b>	<b>1,232</b>	<b>1,519</b>
Direct emission reductions from demand sectors	78	228	437	500
Indirect emission reductions from electricity savings	62	412	794	1,019
<b>Total</b>	<b>452</b>	<b>1,182</b>	<b>2,674</b>	<b>3,524</b>

As seen in Table 3.4, the emissions reduction in 2017 equals to 452 Gg CO<sub>2</sub> eq., which resulted from the new small hydro plants that have been added to Armenia's power system in 2013-2017 (129.9 MW), reduction of electricity losses in electric grid (which reduced from average of 15.2% in 2012 to 10.6% in 2017) and demand side measures.

The GHG emissions reduction potential in 2030 in Energy sector is provided in Table

3.5, where it is split by existing and additional measures in transformation and demand sides. It shows that highest reductions can occur from existing transformation measures, where the largest contribution comes from solar PVs, hydro plants and reduction of electricity losses, while on the demand side the largest reductions come from residential sector, followed by transport sector.

**Table 3.5 GHG emissions reduction potential for 2030, Gg CO<sub>2</sub> eq.**

Mitigation measures	GHG emission reduction, Gg CO <sub>2</sub> eq.	Share, %
Implementation of existing transformation measures	1,465	41.6%
Implementation of existing demand side measures	1,047	29.7%
Implementation of additional transformation measures	541	15.3%
Implementation of additional demand side measures	472	13.4%
<b>Total</b>	<b>3,524</b>	<b>100%</b>

Table 3.6 provides projections of energy consumption indicators from the implementation of the mitigation measures.

It shows that GDP energy intensity, as well as the GHG emissions per GDP will continue to decrease.

**Table 3.6 Energy consumption indicators for WM1 scenario, actual data for 2012-2017 and projections for 2020-2030**

Indicators	2012	2017	2020	2025	2030
GDP, million USD in 2010 prices	10,394	12,365	14,627	18,227	22,715
Population, million people	3.02	2.99	2.96	2.98	2.97
Primary energy supply (TPES), thousand toe	3,105	3,313	3,320	4,004	4,639
GDP energy intensity, toe/thousand USD	0.30	0.27	0.23	0.22	0.20
Per capita primary energy consumption, toe/person	1.03	1.11	1.12	1.34	1.56
Energy Sector GHG emissions, Gg CO <sub>2</sub> eq.	6,892	7,087	6,983	9,016	11,068
GDP emissions intensity for Energy Sector, ton CO <sub>2</sub> eq./thousand USD	0.66	0.57	0.48	0.49	0.49

### 3.3 Gender Aspects of Mitigation Actions in Energy Sector

Women and men show different behavior in terms of energy consumption due to the clear difference and distribution of their roles within the household. 96% of women in Armenia spend 5 to 6 hours a day managing their household and taking care of the family, whereas only 53% of men do such work for only 2 hours a day on average.<sup>39</sup> Some women combine the burden of care for the family and children with the roles of the "breadwinner" and "guarantor of family welfare," perceived as a typically male role. According to the latest surveys, the share of female-headed households in Armenia was 34.4%<sup>40</sup>.

Given this situation, women can be considered as beneficiaries of "clean" energy consumption and energy efficiency, due to the following factors<sup>41</sup>.

- Improving living conditions which will allow women to relieve the burden of caring for family members, especially of children and the elderly.
- Saving time on running a household, which will allow a woman to use her free time for other activities, including paid ones;
- Reducing energy costs, which will allow a woman to save money for other

targeted expenses, in particular the education of her children.

Considering that development and promotion of renewable energy and energy efficiency are among the top priorities of the country, the gender impact of measures implemented in these areas should come to the foreground.

In terms of energy consumption, the amount of energy used for space heating and hot water along with characteristics of relevant equipment are among the indicators characterizing the living conditions directly relating to the family care. Thus, the share of households using fuelwood, manure and other solid fuels decreased from 36% (2018) to 34.4% (2019) over the past year, while the use of electricity for space heating (for heating water also) increased from 12.8% to 18.4% during the same period.<sup>42</sup> It is common knowledge that burning solid fuels inside the house, in homemade stoves, poses a danger to women and children, who spend most of their time next to such stoves, breathing polluted air.<sup>43</sup> Installing solar water heaters and solar panels by households will certainly improve the living conditions for women and children,

<sup>39</sup> The sampled survey on the use of time in Armenia was conducted by the Statistics Committee of the Republic of Armenia with the technical assistance, provided by the Swedish International Development Agency (SIDA) and included surveys of 1342 members, aged 15-80 and representing 512 households.

<sup>40</sup> poverty\_2020\_a\_2.pdf (armstat.am)

<sup>41</sup> "Energy demand, supply and efficiency in rural areas in Armenia. Baseline Data Collection and Analysis." Report. (biodivers-southcaucasus.org)

<sup>42</sup> poverty\_2020\_a\_4.pdf (armstat.am)

<sup>43</sup> According to the World Health Organization (WHO), it can have the same detrimental effect on health as smoking two packs of cigarettes a day. (who.int)

providing them with a healthier environment. At the same time, permanent availability of hot water contributes to more effective solutions of family care problems by women.

Access to affordable electricity for using household appliances is a necessary precondition for women in terms of saving time and being able to be engaged in profitable activities.

The transition of households to the use of renewable (solar) energy will significantly improve women's opportunities to be engaged in other activities that might be beneficial for all. The gender-positive impact of renewable energy is most significant in rural areas, as rural women, on average, spend an hour longer on housework and family care.<sup>44</sup> At the same time, targeting non-gasified and vulnerable rural communities for supporting installation of solar water heaters and PV panels will have not only gender, but also a significant social impact. Such program on installation of solar water heaters and PV panels is implemented by the Renewable Resources and Energy Efficiency Fund of Armenia in partnership with ACBA Leasing and GlobalCredit.<sup>45</sup> The socially vulnerable households, involved in this program, are subsidized by these organizations.

The behavior towards energy saving of households in Armenia is mainly associated with a decrease in heating costs, which predominate in their winter utility costs, amounting to 14-15%.<sup>46</sup> Thermal insulation of buildings is the best option for households to save energy, which, according to expert estimates, can save 30 – 50% of energy consumption for space heating if the indoor temperature is maintained at an average of 20°C.

In Armenia, the actions taken in this direction, come in a limited scope, but the already collected data show that female-headed households will benefit the most from insulation of buildings (both in terms of cost savings and in terms of space heating). Thus, household survey in multiapartment buildings in Yerevan showed that it is more difficult for female-headed households to invest in an apartment-level energy-efficient heating system to heat the entire area of apartment on a permanent basis than for male-headed households. Only 44% of female-headed households were able to afford the installation of such a system versus 58% of male-headed households, and 56% of female-headed households are not able to heat the entire area of the apartment permanently. As a result, the temperature in 53% of their homes is below 18°C (the indicators for male-headed households are 40% and 42%, respectively).<sup>47</sup> At the same time, the energy consumption costs of female-headed households for heating an area of 1m<sup>2</sup> are almost the same, amounting to 93% of male-headed households' costs. In this case, thermal insulation of the building under a co-financing scheme (with the participation of the condominium, the municipality, donor and other organizations) will allow them to save both capital costs and energy costs, at the same time contributing to its "thermal comfort."

It is important to note that about 40% of the surveyed households said that the costs for children's education and the healthcare for the elderly constituted the largest and most burdensome share of household expenses they were struggling to cover. Highly likely that the money saved by households will be used for the educational and health care of family members.

<sup>44</sup> time\_use\_09a (1).pdf

<sup>45</sup> <https://biodivers-southcaucasus.org/uploads/files/Final%20Arm.pdf>

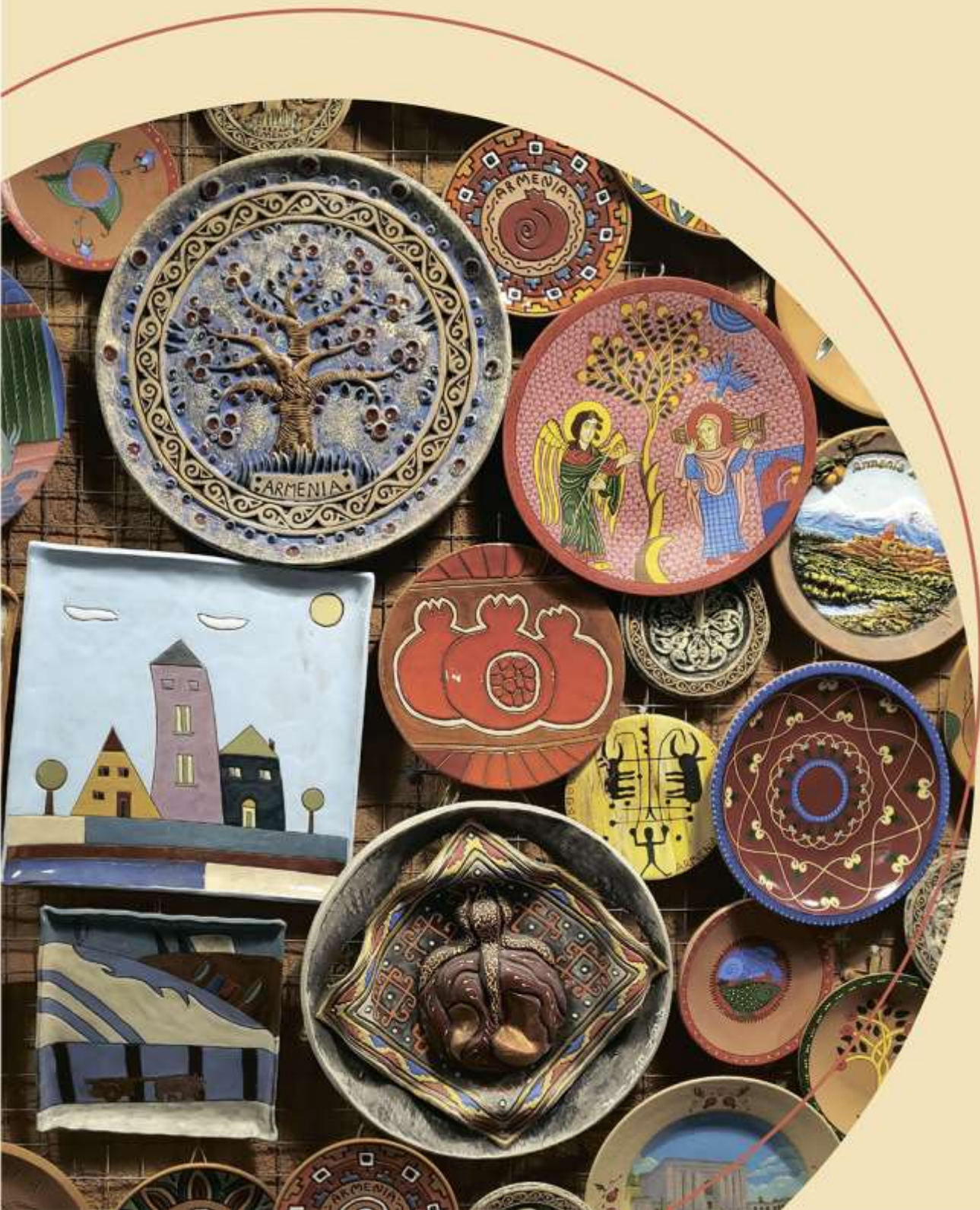
<sup>46</sup> Poverty\_2020\_A\_3.docx (armstat.am)

<sup>47</sup> 79 families, 34 of which were female-headed were surveyed in November-December 2019. Climate Change Information Center (nature-ic.am)



# CHAPTER 4

## SUPPORT RECEIVED AND NEEDS



## 4.1 Support received

Armenia is vulnerable to the negative impacts of the climate change and highly dependent on energy imports, thus needing significant investments in mitigation and adaptation actions. Given the lack of available domestic financial resources, it is important to ensure efficient use of existing resources and planning investments more strategically. Therefore, complete information on the support received and analysis of the results achieved will support the country with these objectives.

During the reporting period (2017-2019)<sup>48</sup> Armenia continued receiving support for climate change mitigation and adaptation measures. Assistance was provided through both bilateral and multilateral international cooperation, including the climate finance, technology transfer, as well as capacity building, while multilateral funding predominated in the total amount of the financial support received.

The received international support was aimed at contributing to the country's low-emission development through implementation of sectorial policies and priority programs, as well as the promotion of business solutions which the best serve to the country's economic and environmental development goals.

In collecting the data on support received finance information was gained from database of Organization for Economic Cooperation and Development (OECD) and other publicly available sources (program documents and reports, periodic donor reports, financial institutions' data), as well as from the relevant state authorities. It should be noted, that there is some inconsistency between the OECD

database and donor's official information (the relevant program documents)<sup>49</sup>.

Different financial instruments including grants, concessional and non-concessional loans have been used to deliver mitigation-related delivery support. In the case of multilateral assistance, the debt instruments have become widely used, while bilateral assistance was provided through grants.

Energy Sector got the largest amounts of climate-related development finance, as the key mitigation measures planned for implementation in 2017-2021 cover primarily the Energy sector, which is the most substantial contributor to national GHG emissions. The special focus on maximization of effective use of the renewable energy potential and energy efficiency measures is in line with the national priority to ensure energy independence and security of the country.

Financial support was also provided in the areas of solid waste recycling, environment protection, agriculture and water resources management.

The Ministry of Environment is involved in a range of climate-related projects supported by international sources. However, many other ministries and governmental agencies as well as domestic public financing mechanisms also engage in or co-finance such projects.

The table below presents, to the greatest extent possible, information on the support received for mitigation actions given the difficulties in obtaining this information in the absence of formal arrangements ensuring collection of data related to support received for climate-related projects on a continuous basis.

<sup>48</sup> Although the reporting period was chosen 2017-2019, nevertheless the table includes several programs started earlier, the funding of which was added during 2017-2019.

<sup>49</sup> For example, the European Bank for Reconstruction and Development (EBRD) financing for the the Distribution Network Modernization project according to project documents is \$ 80 million, while the OECD website states \$ 37.6 million. The table for this and other similar projects is based on the amount of funding mentioned in the official documents of the donors of the respective programs.



**Table 4.1 Support received**

Year	Project	Donor	Type of support				Project objective
			Financial resources	Capacity building	Technical support	Technology transfer	
2017-2020	Strategy program for the optimization of public transport (PT)	ADB/ Sustainable Urban Development Investment Program (SUDIP)	Euro 17.2 mln (Total budget of the project including ADB loan)		✓	✓	This Activity implies PT pool renewal, management and technical optimization, modernization of the ticket system and schedules.
2015-2017	“Institutional strengthening” Program (4 <sup>th</sup> stage)	Multilateral Fund /United Nations Industrial Development Organization	Grant: USD 120,000	✓	✓		The strengthening and effective functioning of the National Ozone Unit by adopting alternative technologies for preservation of ozone layer, establishing a reliable system to collect and monitor data on ozone depleting substances, their imports, exports and production and raising public awareness on the issue.
2017-2021	Improvement of road infrastructure	ADB, SUDIP	Euro 82.8 mln (Total budget including ADB loan)		✓	✓	Unloading the road and street network of the capital
2018	Eastern Europe Energy Efficiency and Environment Partnership Fund-Armenia Window	Germany (EBRD as channel of delivery)	Grant: USD 3,540 mln	✓	✓	✓	Financial support to be used for supporting energy efficiency and environmental projects.
2016	Household Energy Efficiency Mortgage Loans	KfW, NMC	Credit line: KfW: Euro 20 mln Technical assistance funding Grant: EUR 1.5 mln from EU NIF	✓	✓	✓	Provide loans for on-lending to private households to finance energy efficiency investments in housing for low- and middle-income families
2016-2018	Making pavers from plastic trash for future clean cities	EU/ Urban foundation	Grant: EUR 509,978	✓	✓	✓	Provides opportunity to collect plastic waste in 10 selected cities and turn it into sand-polymeric pavement or tile blocks in a workshop founded by the project.
2016 - ongoing	GAF Refinancing loan II/Energy Efficiency Program for SMEs (GAF-EE)	KfW	Loan: Euro 22.24 mln		✓	✓	Promote environmentally friendly businesses through provision of energy efficiency and renewable energy loans to MSMEs.
2016-2019	“Enhancing SME competitiveness through promotion and wider use of sustainable innovative technologies”	Educational and scientific services for the University of Florence, Italy (Lead partner); Tourism Regional Center, Municipalities and Communities	Grant: Euro 2.085 mln (EU Contribution: Euro 1.5 mln)	✓	✓	✓	Promotion of environmentally friendly tourism (eco-tourism) and adoption of renewable energy sources and efficient energy practices in the tourism sector

2016-2020	Mainstreaming Sustainable Land and Forest Management in Mountain Landscapes of North-Eastern Armenia	GEF, UNDP, World Wide Fund for Nature (Armenia), Caucasus Nature Fund	Grant GEF: USD 2,977,169 UNDP: USD 180,000 World Wide Fund for Nature: USD 376,500 Caucasus Nature Fund: USD 286,200	✓	✓	✓	Secure the continued flow of multiple ecosystem services and ensure conservation of wildlife habitats through land and forest sustainable management in the north-eastern Armenia (Lori and Tavush marzes)
2016-2020	Implementation of the Shared Environmental Information System (SEIS) principles and practices in the ENP East region	EU, Ministry of Environment of Armenia	Grant: USD 7 mln (Total budget for the project's beneficiaries six Eastern Partnership countries)	✓	✓		Support the environmental protection by strengthening environmental governance
2017	Irrigation system enhancement project	WB	Loan of USD 2 mln was provided by the WB in addition to the original loan of 30 mln		✓	✓	Reduce energy consumption and improve irrigation conveyance efficiency in the targeted irrigation schemes
2017-2020	Small grants programme	UNDP-GEF	Grant: USD 114,673	✓	✓	✓	Introduction of "green" technologies
2017-2020	Modernization of Distribution Network	EBRD	Loan: USD 80 mln		✓	✓	Improve the quality of the distribution network and services of its multi-site operations across the country, reduce electricity losses and operational expenses, improving technical maintenance and safety conditions, modernizing the metering system, rehabilitating, reinforcing, and augmenting the distribution network
2017-2021	Distribution Network Rehabilitation, Efficiency Improvement, and Augmentation	Asian Development Bank	Loan USD 80 mln		✓	✓	Improve the quality of the distribution network and services of its multi-site operations across the country, reduce electricity losses and operational expenses, improving technical maintenance and safety conditions, modernizing the metering system, rehabilitating, reinforcing, and augmenting the distribution network:
2017	Advanced science & partnerships for integrated resource development	USAID	Grant USD 300,000	✓	✓	✓	Promote science, technology, and innovation in Armenia through engaging with the public and private sectors on energy and water issues including support to innovative approaches to RE pilots
2017	Yerevan "Green city" Action Plan	EBRD, Czech Government's Official Development Assistance Technical Cooperation Fund	Grant: EUR 500,000	✓	✓		Identify Yerevan's key environmental challenges, outlines its long-term strategic objectives as well as proposes mid-term targets and short-term priority actions to address these challenges.
2017	Yerevan Energy Efficiency in Public Buildings	EIB	Loan: EUR 7 mln	✓	✓	✓	Support the Municipality of Yerevan in implementing a rehabilitation programme involving energy efficiency

							and integration of renewable energy measures in public buildings.
2017-2018	Solar Development Projects	Sustainable Energy Development Fund, Philip Morris International	Grant USD 150,000	✓	✓	✓	Reduce energy costs by promoting hot water and electricity use from solar energy
2017-2022	Re-equipment of public electric transport (Yerevan Metropolitan)	EBRD	EUR 21 mln (Total budget including loan from EBRD)		✓	✓	Construction of a drainage tunnel, partial shutdown of pumping stations, modernization of 15 escalators, installation of additional ventilation equipment, replacement of 6kV cable network, re-equipment of substations, modernization of the lighting system.
2017-2019	Readiness support program	Green Climate Fund	Grant USD 300 000	✓	✓		Provide the platforms for broad dissemination of information relevant to international climate finance, particularly the Green Climate Fund.
2017-2019	“Regulatory Framework to Promote Energy Efficiency in Countries of the Eurasian Economic Union” UNDP-RTF regional project	Russian Trust Fund/ UNDP	Grant USD 8.510 mln (total budget for five participating countries)	✓	✓		Realization of energy saving potential in lighting, household appliances and engineering equipment of buildings via introduction of modern energy efficiency standards.
2017-2020	Hydrochlorofluorocarbons (HCFC) Phase-out Management Plan, Stage II (HPMP Stage II)	Montreal Protocol	Grant: USD 141,539	✓	✓		Assist the Government of Armenia to meet its international obligations under the Montreal Protocol on the gradual phase-out of HCFCs from the economic sectors, as well as enable a more targeted accounting of the use of ozone depleting substances in Armenia and allow making relevant steps to the reduction.
2017-2020	Climate change impact mitigation in Armenia by developing forest and field fire management capacities	RF	Grant: USD 1,265,128	✓	✓	✓	Revise and update policy and legislation for prevention of wildfires as part of sustainable forest management system, as well as to establish operative-functioning early warning system
2017-2023	Promotion of Renewable Energy	KfW	Loan: EUR 5.6 mln (through German-Armenian Fund)	✓	✓		Investments in renewable energy sources of energy generation (small hydropower plants, solar photovoltaic stations, solar thermal heaters)
2017-2023	De-risking and Scaling-up Investment in Energy Efficient Building Retrofits	GCF	Grant: USD 20.42 mln	✓	✓	✓	Scale-up investment in energy efficiency building retrofits in Armenia and reduce the overall investment risk of energy efficiency building retrofits to encourage private sector investment and reduce fuel poverty.
2017-2036	Solid waste management system development strategy of the Republic of Armenia	EBRD, EIB, EU Neighbourhood Investment Facility	Loan: EUR 13.5 mln EBRD, EUR 8 mln EIB Grant: EUR 11.5 mln EU Neighborhood Investment Facility	✓	✓	✓	Reduction of CH4 emissions by improving the SW management system

2018	GEF SGP sixth operational phase-Strategic implementation using Star resources, Tranche 2 (Part IV)	GEF Trust Fund	Grant USD 320,000 Grant USD 470,000	✓	✓	✓	Support the creation of global environmental benefits and the safeguarding of the global environment through community and local solutions that complement and add value to national and global level action
2018	Private Sector Utility Scale Solar Power Support Project	CIF-IBRD	Grant: USD 2 mln from SREP through IBRD Loan: USD 26 mln from SREP through IBRD	✓	✓	✓	Increase privately owned and operated solar electricity generation in Armenia.
2018	Development of renewable energy technologies	Lithuania, Ministry of Environment	Grant: USD 67,273	✓	✓	✓	Development of renewable energy technologies
2018	Passive Solar Greenhouse, Phase II: Piloting Passive Solar Greenhouse Project in Gegharkunik Region	Government of Romania	Grant: USD 35,000	✓	✓	✓	Demonstrate the advantages of climate change risk resistant, alternative (non-conventional) energy-effective architectural model greenhouse for year-round fresh crop cultivation in vulnerable communities
2018	The project for installation of solar photovoltaic power system in Azatan village	Japan, Ministry of foreign affairs	Grant USD 65,000	✓	✓	✓	Instal a Solar Photovoltaic Power System (70kW) in Azatan Village to provide electricity to public facilities' self-sustainably.
2017-2021	Re-equipment of public electric transport (trolleybuses) pool and infrastructures	EBRD	Euro 28 mln (Total budget, including Loan from EBRD)	✓	✓	✓	Modernization of the trolleybus pool, renovation and modernization of the overhead contact system, modernization of traction substations, renovation and improvement of the cable network
2018-2021	EU for Yerevan Solar Community	EU Delegation to Armenia within the framework of the second phase of the Covenant of Mayors "Pilot Projects Regional Program"	Grant: Euro 1 mln	✓	✓	✓	Support the multi-apartment building management bodies (condominiums) in managing the energy use through roof top PV systems to cover the energy consumption used for common areas.
2018-2021	EU for Armenia's Sustainable Energy Programme	EU Delegation to Armenia within the framework of the second phase of the Covenant of Mayors "Pilot Projects Regional Program"	Grant: Euro 0.718 mln	✓	✓	✓	Development of a viable model for a community-lead renewable energy generation and sustainable energy transformation in Arik and Aparan cities
2018-2021	National Adaptation Plan. Medium-term and long-term planning support	Green Climate Fund (GCF)	Grant: USD 2.999.593	✓	✓		Lay the groundwork for systemic and iterative identification of medium- and long-term risks, CCA priorities and specific activities that promote climate adaptive and resilient growth in its key sectors.
2018-2021	"Innovative Solutions for SDG Implementation in Armenia" Project	Russian Federation and Government of Sweden	Grant: USD 1 mln from Russian Federation, USD 22,960 from Government of Sweden	✓	✓	✓	Popularisation of solar solutions for private households in targeted regions and introduction of affordable financial instruments to empower vulnerable population to combat "energy poverty".
2019-ongoing	Investments in green technology (RE and EE) for Small and medium-sized enterprises (SMEs) and corporates	EBRD, Green Climate Fund (GCF), Climate Investment Fund (CIF) (implementing agency- GEFF)	Loan: USD 20 mln is co-financed by the EBRD, GCF, CIF	✓	✓	✓	Provide finance, advice and incentives to help businesses become more competitive by investing in high-performance technologies and adopting energy efficiency practices

2019	Armenia's Third Biennial Update Report to the UNFCCC	GEF	Grant: USD 352,000	✓	✓		Assist the Republic of Armenia in the preparation and submission of its Third Biennial Update Report to the UNFCCC
2019	Support the development of EE lending product within the commercial banks, enabling households and business customers to take loans for EE improvements	Green for Growth fund (GGF)	In 2019 GGF added USD 2 mln loan facilities through ACBA Leasing commercial bank to further strengthen EE lease financing portfolio (The previous amount of the loan was USD 22.354 mln)	✓	✓	✓	Create energy efficiency credit lines for households and private sector
2019	Masrik-1 Solar Power Plant	IFC, EBRD, European Union's Neighbourhood Investment Platform (NIP)	Loan: USD 35.4 mln provided by the EBRD together with the IFC Grant: EUR 3 mln from the NIP	✓	✓	✓	Support the Armenian government's strategy of fostering low carbon generation.
2019-2022	EU For Climate Change	EU, UNDP	Total amount of EU budget contribution: EUR 8 mln, UNDP co-financing: EUR 800,000 for six Eastern Partnership countries	✓	✓		Strengthen the capacity for domestic implementation of the Paris Agreement. Enhance transparency of emissions and climate actions.
2019	Zangger Copper Molybdenum Combine (ZCMC) bond participation	EBRD	Equity and shares USD 11 mln		✓	✓	Finance investment projects aimed at improving energy efficiency and CO <sub>2</sub> reduction.
2020	Yerevan Bus Project	EBRD	Sovereign loan: Euro 25 mln	✓	✓		Assist the city to reform its public transport system by financing the renewal of its bus fleet in anticipation of the restructuring of the bus network.
2020-2022	NDC Support Programme	Government of Germany (BMZ)	Grant: USD 91,800	✓	✓		With the support of the NDC Partnership, Armenia is developing and implementing NDC Partnership Plan to support the implementation of Nationally Determined Contributions.



## 4.2 Constraints, gaps and needs to improve reporting under BURs

**Table 4.2 Constraints, gaps and associated needs in relation to the reporting in BURs**

Thematic Area	Gaps or constrains	Associated needs	Type of Need				Priority
			Financial	Capacity-building	Technical	Techno-logy	
Cross-cutting	<p>Currently reporting to the UNFCCC is carried out through ad hoc support for capacity building activities under NCs and BURs and performed by external experts hired through UNDP. There are certain constraints and challenges in relation to institutionalizing the UNFCCC reporting process, namely:</p> <ul style="list-style-type: none"> <li>• Availability of national funds to finance the continuous MRV process for climate change.</li> <li>• Limited human resources and low capacity of public servants in understanding the UNFCCC reporting process and requirements.</li> </ul>	<ul style="list-style-type: none"> <li>• Developing and implementing the national MRV system</li> <li>• Institutionalizing data collection and BUR preparation process</li> <li>• Creating continuous funding mechanisms for activities related to reporting.</li> </ul>	✓	✓			High
Inventory preparation	Lack of formal arrangements ensuring collection of the required data for the compiling GHG Inventory on a continuous basis.	Setting up and maintaining cooperation agreements with relevant ministries, agencies and private sector organizations to ensure regular supply of data in the required format.		✓			High
	Mismatch of natural gas consumption values for industry sector provided by the SC (which splits the consumption by different sub-sectors) and by the PSRC.	Collaboration with the SC to ensure consistency of natural gas consumption data for industry sector with the PSRC's provided data in natural gas balances.		✓	✓		High
	High uncertainty on the distribution of liquid fuels consumption in different sectors.	Enhancing capacities of SC in quality assurance of the fuel consumption data for industry sub-sectors and in other demand sectors.		✓	✓		High
	Lack of data on liquid fuels composition hampering the use of higher tier approaches to estimate emissions from key categories associated with combustion of liquid fuels.	Equipping national laboratories with equipment for analyzing the composition of liquid fuels available on national markets.	✓			✓	High

Thematic Area	Gaps or constrains	Associated needs	Type of Need				Priority
			Financial	Capacity-building	Technical	Technology	
	A certain inconsistency of data used for Energy balance and GHG Inventory, namely: inconsistency of data on fuelwood consumption provided by the authorized bodies in charge of the forestry sector and derived from Household survey conducted by the SC.	Technical assistance and collaboration with the SC, MoE and GHG Inventory compilers to ensure consistency of data and to improve the accuracy/quality of data collected by SC within Household Survey.		✓			High
	Lack of complete and reliable data on HFCs use in the country.	Enhancing capacities of the data providers and performing necessary surveys for statistical data collection.		✓			High
	Lack of data for certain key categories such as Direct and Indirect N2O Emissions from Managed Soils (3.C.4 and 3.C.5), hampering application of higher Tier approaches.	Enhancing capacities of statistical entities to collect the data needed to move to higher tiers in all key categories, through performing necessary surveys and other procedures for statistical data collection.	✓	✓			High
	Lack of complete and reliable data on the recent changes in forest lands because of 25-year absence of nation-wide forest inventory.	Implementation of the nation-wide forest inventory.	✓				High
	Lack of information on the composition of solid waste, which would increase the accuracy of emission estimates from solid waste.	Carry out the research to estimate the solid waste composition in different regions of Armenia.	✓				Medium
	4 source categories are “not estimated” in the GHG inventory due to lack of data, namely: Settlements Remaining Settlements (3.B.5.a), Harvested wood products (3.D.1), Biological treatments of waste (4B), Waste incineration (4CA).	Enhancing capacities of statistical entities in collecting the data for: waste incineration, amount of composted waste, harvested wood products and settlements.		✓	✓		Low
Mitigation Actions	Lack of formal arrangements ensuring collection, analysis and quality assurance of data on mitigation measures implemented in the country and their effect on a continuous basis. As a result, there is a risk of overlooking mitigation actions or of double counting reductions, especially in the Energy Sector.	Developing the MRV system for continuous reporting on mitigation actions by state and private organization.	✓	✓	✓		High
	Lack of common approach in assessing effect of mitigation measures in Energy Sector.	Enhancing capacities of national experts in Energy Sector to apply Grid		✓			High

Thematic Area	Gaps or constrains	Associated needs	Type of Need				Priority
			Financial	Capacity-building	Technical	Technology	
		Emission Factor for the Electricity System of the Republic of Armenia.					
	Lack of knowledge/experience for non-energy sector GHG emissions projections	Enhancing capacities of national experts to develop GHG projections for non-energy sectors					Medium
Needs and support	Lack of knowledge/experience for identification of the financial and technology needs for implementation of mitigation and adaptation actions	Enhancing capacities to identify financial and technology needs for implementing mitigation and adaptation actions. Enhancing capacities to quantify the financial needs for implementation of mitigation and adaptation measures		✓	✓		High
	Lack of formal arrangements ensuring data collection on the financial support received for climate-related projects	Developing the MRV system for continuous reporting on support received for mitigation and adaptation		✓			High

# CHAPTER 5

## MEASUREMENT, REPORTING AND VERIFICATION





According to the Law of RA on “Structure and Activities of the Government”, the RA Ministry of Environment is the state body responsible for the development and implementation of the national policy on climate change in Armenia.

Once every five years after the ratification of the Convention, the Government of Armenia approves the list of measures for implementing the country’s commitments under the international environmental conventions including the UNFCCC. The most recent update of the list of measures took place in 2016, when the RA Government Protocol Decision N 49-8 of December 8, 2016, “On approval of the list of measures to be implemented in the fulfillment of the Republic of Armenia’s Obligations Emanated from a number of International Environmental Conventions” was adopted, outlining, inter alia the measures to be implemented within 2017-2021 in fulfillment of the obligations and provisions arising from the UNFCCC and Paris Agreement, as well as assigns the responsible agencies. According to the Decision, the Ministry of Environment of RA assumes responsibility for the overall coordination of development of the GHG inventories, national communications, biennial update reports of Armenia and establishment of the Monitoring, Reporting and Verification (MRV) system.

The cross-sectoral nature of climate change requires involvement of various ministries, agencies and stakeholders, and mandates to coordinate climate change considerations in the sectoral strategies and policies, as well as to monitor the implementation and validation of the reports to the Convention. To this aim, in 2012 the Prime Minister (PM) of the Republic of Armenia adopted Decree N 955 “On the establishment of an Inter-agency Coordinating Council on the implementation of the requirements and provisions of the UNFCCC and the approval of the composition and rules of procedures of the Inter-agency Coordinating Council”.

The Inter-Agency Coordinating Council on Climate Change acts as a horizontal inter-institutional coordination and verification mechanism that carries out validation and approval of the national reports prior to their submission to the UNFCCC. It consists of representatives of different ministries, the

Public Service Regulatory Commission (PSRC), Academy of Science and the Statistics Committee, is chaired by the Minister of Environment and aims to ensure inter-sectoral coordination for implementation of the national climate change policies.

Activities of the Council are supported by a working group established by the same Decree and comprising of the representatives of the ministries, state agencies as well as climate change experts and consultants.

Thus, it can be concluded that the basic national MRV system, comprising of horizontal inter-agency coordination and verification mechanism under the overall formal coordination by the Ministry of Environment, has already been established in the country.

To improve the process of development of the low carbon and climate-resilient policies and reporting under the Paris Agreement, a proposal aimed at updating the composition, mandate, functions and procedures of the Inter-agency Coordinating Council on Climate Change has been developed with support of the UNDP-GEF “National Adaptation Plan (NAP) to advance medium and long-term adaptation planning in Armenia” project and submitted by the Ministry of Environment for the approval by the Prime Minister.

The proposed reform of the Council is aimed to strengthen inter-agency coordination and boost civil society participation in climate change policy-making and implementation, through raising the level of chairmanship of the Council, as well as involving new stakeholders, including representatives of NGOs and private sector.

According to the proposed changes, the new Council is to be chaired by the Vice PM and co-chaired by the Minister of Environment, and composed of representatives of 10 ministries, 4 state agencies, National Academy of Science and PSRC, as well as Advisor to the Prime Minister, Deputy Head of the PM’s Administration, Deputy Chairman of the Standing Committee on Territorial Administration, Local Self-Government, Agriculture and Nature Protection of the RA National Assembly, UNFCCC Focal Point, UNDP Resident Representative and two representatives of an environmental and climate change NGO and private sector.



Furthermore, the draft Decision envisages establishment of 4 new Inter-agency permanent working groups that will replace the existing working group of Inter-agency Coordinating Council and will be tasked to facilitate the work of the Council and provide professional and expert support. The four groups will cover the main areas of national reporting under the Convention and the Paris Agreement. Moreover, a temporary working group is to be established to deal with the matters that are out of the competences of the permanent working groups. The results of all 5 working groups are subject of approval of the Council.

The draft Decision underwent the process of formal consultations with stakeholders towards the approval by the PM in 2021.

However, legal / formal arrangements are still needed to specify particular obligations of corresponding institutions in terms of climate-related data provision and quality assurance.

On 24 November 2017, the Comprehensive and Enhanced Partnership Agreement (CEPA) between the European Union and Armenia was signed. The Agreement emphasizes the importance of strengthening the multilateral cooperation on the

### GHG Inventory

The legal reforms currently in progress will facilitate development of greenhouse gas inventories on a continuous basis. The draft Law “On Atmospheric Air Protection” has been developed envisaging setting set up a unified system for the recording of hazardous substances and GHG emissions, which will contribute to compliance with the obligations of the RA under environmental conventions, as well as to the consistency of information provided under different conventions. The document has undergone intensive consultations with the Government and stakeholders. It is currently being finalized by the Ministry of Environment and will be submitted for the Government approval in 2021.

The Statistics Committee (SC) is the major provider of activity data required for greenhouse gas emissions assessment for IPCC sectors, thus, being an integral part of the domestic MRV system of GHG Inventory.

With the support of UNECE Statistical Division a Road Map for the Development of

further development and implementation of the international climate-change framework under the UNFCCC and agreements and decisions related thereto, including the Paris Agreement. Particularly, it requires the establishment of a national greenhouse gas inventory system and of a national MRV mechanism by 2026.

In order to address this obligation, the CEPA Implementation Roadmap has been approved by Decision 666-L of the Prime Minister and endorsed at the second meeting of the Armenia-EU Partnership Council on 13 June 2019. The Roadmap also requires enlargements of the scope of the current Armenian legislation on the ozone-depleting substances aimed to cover provisions on fluorinated greenhouse gases. To this end, corresponding amendments were made to the Law of RA on Ozone Depleting Substances on 26 May 2020 aimed to extend its coverage so that HFCs are included. Accordingly, the title of the law has been changed to the Law of RA on Protection of the Ozone Layer. Later, on 20 August 2020, the Government Decision No 1368-N on “Approval of HFCs list” was adopted that set a list of 18 HFC gases.

Climate Change-related Statistics was developed and adopted in February 2020 by a Resolution of the State Council on Statistics. The Road Map outlines the priorities and actions for improvement of climate change-related national statistical system, including the data needed for development of national GHG inventories, as well as on climate change mitigation and adaptation efforts.

Further, the Statistics Committee recognizes the need to acquire new knowledge and expertise through training, hiring and, above all, building partnerships with other information providers and experts. It also recognizes that, in the long term, there may be a need for organizational changes to support the development of climate change-related statistics across the entire statistical system, including data reporting, collection, storage and exchange.

Since 2017, SC publishes the Energy Balances of RA on annual basis. Energy Balance is the key source of activity data for

Energy Sector - by far the largest producer of GHG emissions in the country. The Balance provides a comprehensive overview of activity data on Armenia's Energy Sector, and it supports breakdowns in accordance with fuels and categories.

The data for the Balances come from a wide range of sources and are collected by the SC. Therefore, development and improvement of the Energy Balances on a continuous basis, with proper consideration of QA/QC aspects, is extremely important in order to improve accuracy, consistency and completeness of the National GHG Inventory.

To this aim, the GHG Inventory compilers work in close cooperation with the developers of Energy Balance to ensure consistency of data used for GHG Inventory and the Balance. Moreover, the Balance of Armenia for 2018 was compiled by the support of the "Development of Armenia's Fourth National Communication and Second Biennial Update Report to the UNFCCC" UNDP-GEF project, while the Balance for 2019 has been developed with the support of "Armenia's Third Biennial Update Report to the UNFCCC" UNDP-GEF project.

Within the framework of the "Armenia's Third Biennial Update Report to the UNFCCC" UNDP-GEF project, a study was conducted in 2020 aimed to summarize and analyze the existing data collection gaps and to identify optimal formal / legal arrangements ensuring continues data flow necessary for national reporting on GHG emissions.

Proceeding from the national circumstances and existing legal/institutional arrangements, two main options of data collection on a continuous basis were considered.

The first option supposes that all data providers, including entities involved in economic activities will provide data directly to the Ministry of Environment. This option requires certain legislative changes, including adoption of the new Law "On Atmospheric Air Protection". While the second option supposes that collection of all data required for GHG Inventory is carried out by the Statistics Committee and then communicated to the Ministry of Environment on the basis of Memorandum of Understanding signed between two organizations (as it

is in case of Energy Balance). This approach does not require any legislative changes as it is in line with the existing legal requirements, however, it will increase the scope of data to be collected by the Statistics Committee.

Based on the experience gained and lessons learned through development of BURs, and as a result of discussions with the Statistics Committee, the following approach is proposed for the further consideration as the most feasible solution that is a synergy of the abovementioned two options: (i) on a basis of a MoU signed between the Ministry of Environment and the Statistics Committee, the latter provides data within the same scope of information that is currently provided for GHG Inventory development; (ii) individual MoUs on data provision are signed with the state organizations possessing data in respective sectors (e.g. State Revenue Committee, PSRC, Ministry of Economy, etc.) to provide data not addressed by the Statistics Committee; (iii) individual MoUs are signed with utility companies and natural monopolies (e.g. ENA CJSC, Gazprom Armenia CJSC, etc.); (iv) any data from private sector entities that is needed for national reporting and is not covered by the above mentioned three channels, in case of non-adoption of the above mentioned Law, is to be obtained through the Statistics Committee, which will slightly expand the scope of data to be collected by the SC.

These arrangements will be clarified within the framework of the already initiated UNDP-GEF "Building Armenia's national transparency framework under Paris Agreement" (Capacity-building Initiative for Transparency - CBIT) project.

Considering importance of national capacity building for GHG Inventory development, national experts from different sectors participated in the training of GHG Management Institute organized by the UNFCCC. Five of them have passed the qualification exam and were included in the list of technical experts of the Convention, having the right to be involved in the technical review of GHG inventories submitted by Annex I Parties and technical analysis of biennial update reports submitted by non-Annex I Parties.

## Mitigation

The most challenging task while developing BURs was collection and quality control of data needed for assessment of the mitigation actions and their effect. This is because of a big number of actors involved in implementation of mitigation actions on various levels, coupled with the lack of general coordination / monitoring of mitigation measures implementing in the country, resulting in the risks of overlooking some key actions or of double counting reductions.

Hence, identification of data providers and clarification of roles and responsibilities of the multiple stakeholders involved in development and implementation of mitigation actions in the country remains a top priority.

In order to facilitate improvement of mitigation data collection process, in the course of BURs preparation, new templates were developed addressing data provision formats for different types of projects per IPCC sectors.

The updated standardized (ex-ante) baseline on grid emission factor (GEF) for the next 3 years was developed by the Ministry of Environment with the support of “Armenia’s Third Biennial Update Report to the UNFCCC” UNDP-GEF project, and approved by the CDM Executive Board in February 2021. The two previously developed and approved standardized baselines valid for 2015-2018 and 2019-2021 are available on the UNFCCC website. The standardized baseline, once approved, will allow continuing the established practice of the unified and creditable assessment of climate change mitigation effect of renewable energy and energy efficiency activities in the country, thus, ensuring common approach in assessing mitigation measures effect of different measures.

Ex-poste evaluation of the effect of mitigation policies and measures via LEAP model, which was done in the frames of the Armenia’s BURs, allows assessing the real emission reduction in Energy Sector, expressed as a difference between the ex-post evaluation of WOM scenario and the real observed emissions in the targeted GHG inventory year, thus, allowing estimation of the actual progress towards achieving NDC targets.

On the other hand, the projection of GHG emissions per different development scenarios, allows estimating feasibility of reaching NDC targets.

Within the framework of a number of projects, implemented in Armenian under international funding, application of key elements of MRV system or setting up MRV system in corresponding sectors is ongoing or envisaged.

The establishment of domestic MRV system for mitigation actions in building sector is facilitated by the “De-risking and Scaling-up Investment in Energy Efficient Building Retrofits” UNDP-GCF project. Environmental Project Implementation Unit (EPIU) under the Ministry of Environment of RA is considered to be the national partner for the implementation of MRV. To that end, the Roadmap for piloting of Energy Management Information Systems (EMIS) in public buildings, as well as the Report on monitoring methodology for calculation of energy savings and greenhouse gas reductions and detailed system of methods for calculation, normalization and validation of the gathered data have been finalized and submitted to the EPIU.

Project also supports the establishment of EMIS in municipalities and public entities. Particularly, currently the revision of the framework for applying EMIS in Yerevan Community is under discussion.

Municipal Energy Management System (MEMS) establishment is initiated as a part of domestic MRV system. An agreement already has been reached with one of the urban community on the introduction of the MEMS.

In parallel with the process of development of the building sector MRV system, a monitoring and reporting system for GHG inventories and climatic actions on a municipal level has been established through the participation of Armenian communities in the EC’s “Covenant of Mayors for Climate and Energy” initiative. As of January 2021, 27 Armenian municipalities joined the Covenant and took a voluntary commitment to reduce CO<sub>2</sub> emissions and improve climate change resilience in their territories.

In line with the Covenant procedures, municipalities are committed to provide monitoring reports on the progress toward implementation of their mitigation and adaptation actions regularly, via an online reporting platform, where all information and input data associated with GHG Inventory and subsequent monitoring is reported, checked and stored. In other words, 27 municipalities covering a significant part of the country's population are accountable on their GHG inventories and progress on climatic actions through the online municipal

### Adaptation

The draft Decision of the Government of Armenia on "Approval of the National Framework Strategy on Adaptation to Climate Change Impacts for 2021-2030 and the Action Plan for 2021-2025" was developed (approval is expected in 2021), envisaging, inter alia, to establish NAP Accountability, Monitoring and Evaluation (AME) process. It is envisaged that the AME system will build on the country's Monitoring, Reporting and Verification (MRV) system for climate change mitigation.

### Monitoring of climate financing

Establishment of a system for tracking the national and international financial support received for implementation of climate-related mitigation and adaptation activities, is essential for setting an efficient MRV framework that covers all four key reporting areas (i.e. inventory, mitigation, adaptation and support). Substantial progress in addressing climate change related challenges and needs in Armenia has been achieved due to the technology transfer, capacity building and climate finance support received from multilateral and bilateral sources. Nevertheless, the lack of a formal MRV system for support does not provide for the accurate tracking of the climate-related financing received.

In order to identify opportunities and constraints for integrating climate change concerns within the national and sub-national budget allocation and expenditure process, as well as to make recommendations on developing financial frameworks for climate change that will enable, among other benefits, better tracking of climate-related financial support, the Climate Policy and Expenditure Institutional Review (CPEIR) was

MRV system that can potentially serve as one of the sources of data for the national MRV of mitigation and adaptation.

However, considering methodological specifics in assessing effect of municipal mitigation and adaptation activities, there is a need of the careful examination of the applicability of this data and extent of using for the national MRV of mitigation and adaptation.

The AME system will establish reporting processes and mechanisms for adaptation; monitor and track progress on implementation of adaptation processes for cross-sectoral, sub-national, and sectoral measures; promote feedback to foster continuous improvement of the policy and of its management; and assess the impact of interventions on reducing vulnerability.

These arrangements will be clarified within the framework of the already initiated CBIT project.

carried out in the frames of the EU4Climate project in 2020. To this end, the study has reviewed the countries climate change policy, institutional and public finance management frameworks and assessed the volume and structure of climate expenditures.

In parallel with the review, a comprehensive and systematic assessment of the level of integration of climate change finances in the current Public Financial Management System of Armenia has been carried out via application of the Climate Change Budget Integration Index (CCBII).

On the basis of the review and CCBII, a number of recommendations aimed at enabling establishment of transparent domestic MRV system for support received have been made. The report recommends developing a methodology, format and mechanism for the climate change expenditures identification, tagging and calculation, as well as to assess and expand the role of Ministry of Finance in terms of identification, coding, estimating and reporting costs associated with climate change. In the



meantime, it is important to note that the climate-related financial support is provided not only by the domestically and externally financed expenditures that are accountable and transparent under the public finance management (PFM) scheme, but also by the private sector, through bilateral cooperation and other channels that may be overlooked by the PFM system and consequently not reported through MRV. To this end, it is important to explore possibilities for tracking financing for mitigation and adaptation activities implemented by municipalities, non-governmental organizations, private sector and donors, to ensure that any climate-related funding in Armenia is considered and consequently reported under the MRV system.

A preliminary assessment of the investment needs for climate action in Armenia was carried out by the OECD Secretariat in 2020 by the initiative of the Ministry of Environment of RA and the OECD<sup>50</sup> within the framework of the GREEN Action Task Force. The key objective of the project was to provide an evidence base for policy reform discussion among corresponding stakeholders in Armenia and for mobilizing finance for climate objectives in line with the coun-

### QA/QC Practice

To meet quality requirements for the domestic MRV system, the already established QA/QC procedure, applied to ensure the quality of the national GHG inventory and BURs, will be used and improved as needed. In this context, the establishment of the thematic working groups under the renewed Inter-agency Coordinating Council, envisaged by the proposed reform of the Council, will contribute greatly to improved quality of control of GHG inventories and reporting on mitigation, adaptation and support received.

The current QA/QC procedure for NIRs and BURs includes a profound check of integrity and completeness of the data and

try's national targets. According to the results of the preliminary assessment under the considered scenarios, predominant part of the total gross investment needs in Armenia for 2020-2030 period is for climate mitigation, whereas, the lion's share of investments related to climate change mitigation is in the energy supply and energy efficiency sectors.

The report recognizes that many climate-related projects in Armenia are often embedded within a broader, more general development and infrastructure programmes, thus, a large part of the projects could have been implemented without climate-related objectives. Hence, without careful delineation of the incremental (i.e. climate-related) costs from the total costs of the projects, estimation of the provided and needed investments may have been considerably overestimated in Armenia as large infrastructure projects have been qualified as climate-related activities. This further emphasizes the need for establishment of a domestic MRV system for support that will enable careful identification of financial support for climate-related activities and avoiding overestimation of received support.

cross-check of activity data received from different sources carried out by the expert team and the working group, followed by an internal review of the draft NIRs and BURs by the Ministry of Environment, as well as circulation of the draft reports among stakeholder state agencies, organizations and companies. The results of the review are then considered by the relevant national experts to address received comments, make changes or provide clarifications, followed by submission of draft documents to the Coordinating Council for verification and subsequent submission to the UNFCCC.

### Building domestic MRV system through participation in CBIT

Though certain actions have already been undertaken to setup a domestic MRV, the country still lacks the necessary institu-

tional arrangements to formalize the process of continuous monitoring, reporting and verification on climate change.

<sup>50</sup> An Assessment of Investment Needs for Climate Action in Armenia, ENV/EPOC/EAP (2020)4.



To this aim, Armenia has initiated the UNDP-GEF “Building Armenia’s national transparency framework under Paris Agreement” project to be implemented under the Capacity Building Initiative for Transparency (CBIT) to build its institutional and technical capacities to meet the enhanced transparency requirements defined by the Paris Agreement.

The project will establish national institutional arrangements for an enhanced transparency framework to shift from the current practice of ad hoc reporting to a continuous process of MRV that will allow the country to track its progress against its commitments under the NDC, as well as to ensure national reporting under the Convention and the Paris Agreement.

## **ANNEXES**

**Table A-1. Summary report for national GHG inventory for 2017**

Categories	Emissions and Removals (Gg)				Emissions CO <sub>2</sub> eq. (Gg)			Emissions (Gg)			
	CO <sub>2</sub> Emissions	CO <sub>2</sub> Removals	CH <sub>4</sub>	N <sub>2</sub> O	HFCs	PFCs	SF <sub>6</sub>	NO <sub>x</sub>	CO	NMVOCS	SO <sub>2</sub>
<b>Total National Emissions and Removals</b>	5,698.103	-538.028	154.753	3.405	685.337	NO	2.594	13.272	34.010	10.026	48.558
<b>1 - Energy</b>	5,361.500		80.576	0.109				13.066	26.869	2.737	0.181
<b>1A - Fuel Combustion Activities</b>	5,361.311		3.106	0.109				13.066	26.869	2.737	0.181
1.A.1 - Energy Industries	1,297.949		0.023	0.002				2.033	0.891	0.059	0.006
1.A.2 - Manufacturing Industries and Construction	469.861		0.010	0.001				0.962	0.263	0.186	0.044
1.A.3 - Transport	1,723.689		1.810	0.087				8.676	24.823	2.415	0.013
1.A.4 - Other Sectors	1,869.811		1.263	0.018				1.395	0.892	0.077	0.117
1.A.5 - Non-Specified	NO		NO	NO				NA,NO	NA,NO	NO	NA,NO
<b>1B - Fugitive emissions from fuels</b>	0.189		77.470	NA,NO				NO	NO	NO,NE	NO
1.B.1 - Solid Fuels	NO		NO	NO						NO	
1.B.2 - Oil and Natural Gas	0.189		77.470					NO	NO	NE	NO
1.B.3 - Other emissions from Energy Production	NO		NO	NO				NO	NO	NO	NO
<b>1C - Carbon dioxide Transport and Storage</b>	NO							NO	NO	NO	NO
<b>2 - Industrial Processes and Product Use</b>	262.574		NA,NO	NA,NO	685.337	NO	2.594	NA,NO	NA,NO	7.289	48.377
<b>2A - Mineral Industry</b>	258.336										
2.A.1 - Cement production	224.551										
2.A.2 - Lime production	28.352										
2.A.3 - Glass Production	5.433										
2.A.4 - Other Process Uses of Carbonates	NE,NO										
2.A.5 - Other	NO										
<b>2B - Chemical Industry</b>	NO		NO	NO	NO	NO	NO	NO		NO	NO
<b>2C - Metal Industry</b>	NA,NO		NA,NO		NO	NO	NO	NO,NA	NO,NA	NO,NA	48.377
2.C.1 - Iron and Steel Production	NO		NO								NO
2.C.2 - Ferroalloys Production	NA		NA	NA							7.054
2.C.3 - Aluminum production	NO					NO			NO		NO
2.C.4 - Magnesium production	NO						NO				
2.C.5 - Lead Production	NO										
2.C.6 - Zinc Production	NO										

Categories	Emissions and Removals (Gg)				Emissions CO <sub>2</sub> eq. (Gg)			Emissions (Gg)			
	CO <sub>2</sub> Emissions	CO <sub>2</sub> Removals	CH <sub>4</sub>	N <sub>2</sub> O	HFCs	PFCs	SF <sub>6</sub>	NOx	CO	NMVOCS	SO <sub>2</sub>
2.C.7 – Other - Copper Production											41.323
<b>2D - Non-Energy Products from Fuels and Solvent Use</b>	4.237								NO	6.403	
2.D.1 - Lubricant Use	3.991										
2.D.2 - Paraffin Wax Use	0.246										
2.D.3 - Solvent Use										6.401	
2.D.4 - Other - Bitumen/Asphalt Production and Use									NO	0.0021	
<b>2E - Electronics Industry</b>					NO	NO	NO				
<b>2F - Product Uses as Substitutes for Ozone Depleting Substances</b>					685.337	NO					
2.F.1 - Refrigeration and Air Conditioning					653.921	NO					
2.F.2 - Foam Blowing Agents					23.008						
2.F.3 - Fire Protection					0.636	NO					
2.F.4 - Aerosols					7.773	NO					
2.F.5 - Solvents					NO	NO					
2.F.6 – Other Applications					NO	NO					
<b>2G - Other Product Manufacture and Use</b>						NO	2.594				
2.G.1 - Electrical Equipment						NO	2.594				
2.G.2 - SF <sub>6</sub> and PFCs from Other Product Uses						NO	NO				
2.G.3 - N <sub>2</sub> O from Product Uses				NO							
2.G.4 - Other											
<b>2H - Other</b>								NA,NO		0.886	
2.H.1 - Pulp and Paper Industry								NO		NO	
2.H.2 - Food and Beverages Industry										0.886	
2.H.3 - Other										NO	
<b>3 - Agriculture, Forestry, and Other Land Use</b>	69.744	-538.028	48.235	3.065				0.205	7.141	NA,NO,NE	NA,NO,NE
<b>3A - Livestock</b>			48.011	0.185							
3.A.1 - Enteric Fermentation			46.357								
3.A.2 - Manure Management			1.653	0.185							
<b>3B - Land</b>	67.024	-538.028	NO	0.001				NA,NO		NA,NO	
3.B.1 - Forest land	NO	-530.445						NO		NO	

Categories	Emissions and Removals (Gg)				Emissions CO <sub>2</sub> eq. (Gg)			Emissions (Gg)			
	CO <sub>2</sub> Emissions	CO <sub>2</sub> Removals	CH <sub>4</sub>	N <sub>2</sub> O	HFCs	PFCs	SF <sub>6</sub>	NOx	CO	NMVOCs	SO <sub>2</sub>
3.B.2 - Cropland	0.712	-7.438									
3.B.3 - Grassland	18.366	0						NO		NO	
3.B.4 - Wetlands	18.317	NO	NO	0.001							NO
3.B.5 - Settlements	NO	-0.145									
3.B.6 - Other Land	29.629	NO									
<b>3C - Aggregate sources and non-CO<sub>2</sub> emissions sources on land</b>	<b>2.720</b>		<b>0.224</b>	<b>2.878</b>				<b>0.205</b>	<b>7.141</b>	<b>NA,NO,NE</b>	<b>NA,NO,NE</b>
3.C.1 - Emissions from biomass burning			0.224	0.008				0.205	7.141	NE	NE
3.C.2 - Liming	NO										
3.C.3 - Urea application	2.720										
3.C.4 - Direct N <sub>2</sub> O Emissions from managed soils				2.165							
3.C.5 - Indirect N <sub>2</sub> O Emissions from managed soils				0.586							
3.C.6 - Indirect N <sub>2</sub> O Emissions from manure management				0.12							
3.C.7 - Rice cultivation			NO					NO		NO	
3.C.8 - Other			NO	NO							
<b>3D - Harvested Wood Products</b>	<b>NE</b>	<b>NE</b>						<b>NO</b>			<b>NO</b>
<b>4 - Waste</b>	<b>4.284</b>		<b>25.942</b>	<b>0.231</b>				<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>
<b>4A - Solid Waste Disposal</b>			<b>20.296</b>								
<b>4B - Biological Treatment of Solid Waste</b>			<b>NE</b>	<b>NE</b>							
<b>4C - Incineration and Open Burning of Waste</b>	<b>4.284</b>		<b>0.617</b>	<b>0.011</b>				<b>NE</b>	<b>NE</b>		<b>NE</b>
<b>4D - Wastewater Treatment and Discharge</b>			<b>5.028</b>	<b>0.22</b>						<b>NE</b>	
<b>4E - Other</b>	<b>NO</b>		<b>NO</b>	<b>NO</b>				<b>NO</b>	<b>NO</b>	<b>NO</b>	
<b>5 - Other</b>	<b>NE</b>		<b>NE</b>	<b>NE</b>				<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>
<b>5A – Indirect N<sub>2</sub>O Emissions from the Atmospheric Deposition of Nitrogen in NO<sub>2</sub> and NH<sub>3</sub></b>	<b>NE</b>		<b>NE</b>	<b>NE</b>				<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>
<b>Memo Items</b>											
<b>International Bunkers</b>	<b>168.676</b>		<b>0.0012</b>	<b>0.005</b>				<b>0.218</b>	<b>0.065</b>	<b>0.103</b>	<b>0.054</b>
1.A.3.a.i - International Aviation (International Bunkers)	168.676		0.0012	0.005				0.218	0.065	0.103	0.054
1.A.3.d.i - International water-borne navigation (International bunkers)	NO		NO	NO				NO	NO	NO	NO
1.A.5.c - Multilateral Operations	NO		NO	NO				NO	NO	NO	NO



**Table A-2. Emissions from product uses as substitute for ozone depleting substances for 2017, CO<sub>2</sub> eq.**

Categories	HFC-32	HFC-125	HFC-134a	HFC-152a	HFC-143a	HFC-227ea	Total HFCs
<b>Emissions in CO<sub>2</sub> equivalent unit (Gg CO<sub>2</sub>)</b>							
<b>2.F - Product Uses as Substitutes for Ozone Depleting Substances</b>	25.091	230.710	237.126	1.438	190.336	0.636	685.337
2.F.1 - Refrigeration and Air Conditioning	25.091	230.710	207.785	0	190.336	0	653.921
2.F.1.a - Refrigeration and Stationary Air Conditioning	25.091	230.710	114.118	0	190.336	0	560.255
2.F.1.b - Mobile Air Conditioning	0	0	93.667	0	0	0	93.667
2.F.2 - Foam Blowing Agents			21.9127	1.095		0	23.008
2.F.3 - Fire Protection		0	0			0.636	0.636
2.F.4 - Aerosols			7.430	0.343		0	7.773

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